American Machinist

November 23, 1932

# Quality of Metal Surfaces

JOHN GAILLARD
*Mechanical Engineer,*
*American Standards Association*

**Graphical records of surface unevenness provide an accurate method of analyzing the finish produced by various tools**

QUALITY of surface of metal parts—that is, generally speaking, the size, shape, and distribution of minute unevennesses—has a direct influence on the fitting together of these parts and consequently on their functioning and rate of wear. Parts required for running fits are now often finished to a high quality of surface, for example by grinding followed by lapping or honing, instead of being given a lower quality of finish the improvement of which is left to running-in of the parts when assembled. In the latter case, the abrasive action of metal particles loosened from parts during the running-in period exert a damaging influence on the surface which is avoided when parts having the proper finish are assembled.

Surface quality concerns not only machined parts, however, but also parts and semi-finished materials made by such processes as casting, cold drawing and rolling. A certain quality of surface may also be required solely from the viewpoint of appearance.

The problem has arisen how to express surface quality in terms of measurement so that different qualities may be compared and also indicated on drawings and in specifications by symbols, numbers, or names that have a definite standard meaning instead of by the different terms now used by individual firms. A technical committee on this subject was recently organized under the procedure of the American Standards Association—joint sponsors: American Society of Mechanical Engineering and Society of Automotive Engineers.

No complete solution of this problem has as yet become known, but an interesting study in this field was published as a doctor of engineering thesis by a German engineer, Willy Kiesewetter, as the result of investigations made at the Engineering Academy of Dresden. Some of Dr. Kiesewetter's findings and a summary of different methods used are given below.

One method of judging a surface consists in making a cast of gelatine or some other plastic material. This cast is cut to thin slices each of which when viewed under microscope shows an outline of the surface. This method can be used for unevennesses down to about 0.0001 in. However, because of the warping of the cast and the slices, the method is not reliable from the viewpoint of accurate measurement. At best it gives a general impression of the nature of the surface.

An improvement of the method just described was successfully applied by Dr. C. B. Sawyer of Cleveland, Ohio, and described in the appendix to R. E. W. Harrison's paper on the subject. It consists in copper plating the surface investigated, the parts in question being then cut in two and the cross-section inspected under the microscope. The copper plating keeps the unevennesses of the original surface in shape during the cross-sectioning process.

Several optical methods for investigating surface quality have been proposed. A simple one consists in letting the surface reflect a certain object, for example a piece of a newspaper, the degree of clearness and accuracy with which the printed type is reflected being taken as a basis for judging the surface quality. A surface can also be investigated by means of the light interference effects produced by an optical flat.

Another optical method is based on the fact that, for any surface whose unevennesses lie within definite limits, there is a certain angle at which the reflection of figures changes from diffused to regular. This method does not work for unevennesses smaller than about 0.00004 in., nor for those larger than 0.00024 in. In the former case, the surface gives regular reflection at any angle and in the latter case, at no angle.

Some optical instruments are based on the principle of determining the ratio between the amount of light reflected by the surface in the diffuse and in the regular manner, respectively. In final analysis, all of these photometric methods give a basis of comparison for the glossiness of the surface, but no definite basis of measurement for its quality.

A method of translating the number of unevennesses per inch of length of the surface concerned into frequency of sound vibration—or in other words into tone of a certain pitch—was developed by R. E. W. Harrison in a paper presented at the annual meeting A.S.M.E., December 1930, entitled "A Survey of Surface Quality Standards and Tolerance Costs Based on 1929-1930 Precision Grinding Practice." A needle is moved over the surface investigated and the impulses caused by the unevennesses are electrically transmitted to a loudspeaker. They may also be transmitted to a millivoltmeter causing the latter to deflect.

Oscillograms obtained by this method give a permanent record of the nature of the surface.

Direct investigations of surfaces have also been made by means of a needle. Its point travels over the unevennesses, and the resulting displacements are either projected to an enlarged scale on a screen, or recorded on a moving strip of photographic paper by a beam of light reflected by a small mirror connected with the needle. The needle may also be provided at some distance from its point with a diamond recording point which finely scratches the record of the needle's ups and downs into a piece of glass attached to the test piece. This record may be examined under the microscope or enlarged.

### Two Curves Combined

The investigations made by Dr. Kiesewetter were carried out by means of gramophone needles. The diameter of their point, found to average about 0.0025 in., determines the depth to which the point will go down into the valleys of the minute unevennesses. When it does not reach the bottom, the profile curve recorded will become shallower than it should. This difficulty was overcome in an ingenious manner. A cast of copper amalgam of the surface investigated was made and a profile curve of this cast was recorded with the same needle. The valleys of the original surface become the peaks of the cast, and these can be recorded without error. A combination of the two curves thus obtained gives the true profile of the original surface.

With a view to wear, each needle was used for recording only twenty surface curves. The needle was kept in contact with the surface by a pressure of about five grams. The speed of the recording paper was 100 times the speed with which the test piece was moved past the needle. The reliability of the method was proved by the fact that two curves of the same surface consecutively recorded, were found to be completely identical.

A number of curves recorded by Dr. Kiesewetter are shown in Figs. 1 to 7. The kind of metal of which the part was made and the method by which the surface was finished are indicated in each case. In the horizontal direction, the scale of all surface curves is 50 to 1, or in other words, one inch of the diagram represents a length of 0.02 in. measured on the actual surface. The vertical scale of the curves is indicated for each diagram, together with the value $h$ representing the average depth (arithmetic mean) of the valleys of the entire curve determined by means of a planimeter. Only in case where the curve differed too little from a straight line the value $h$ is not given.

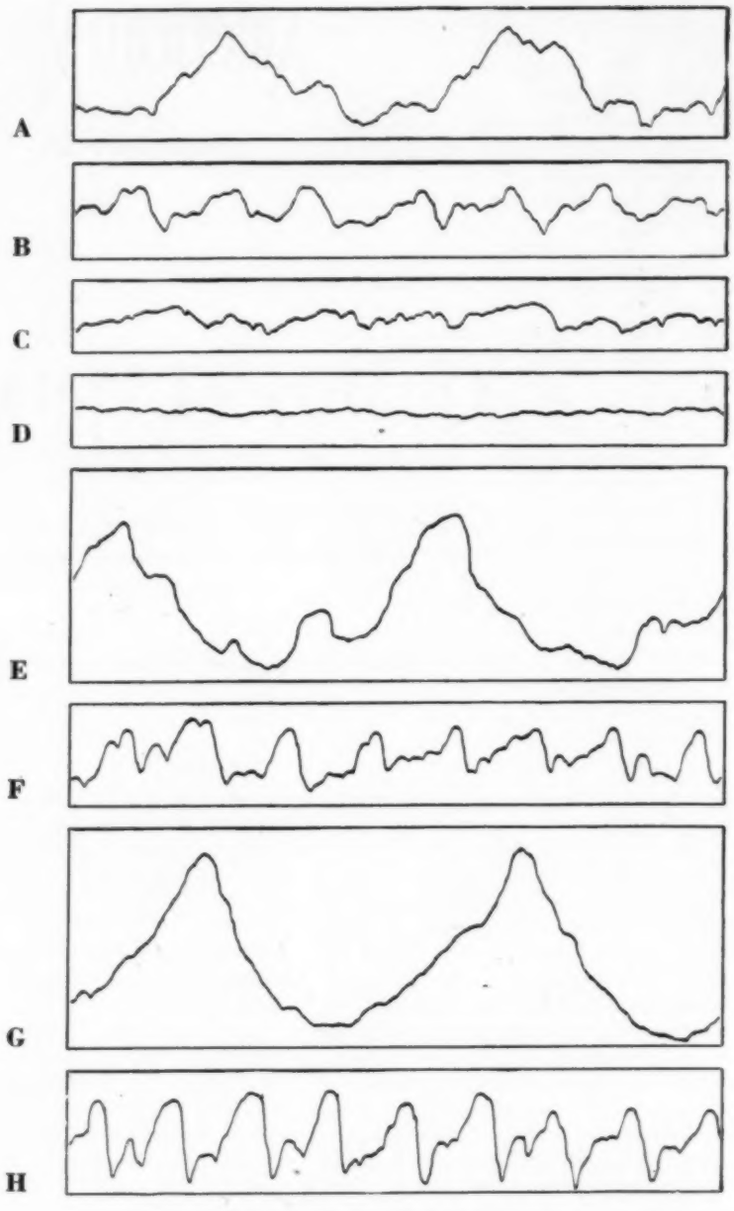



**Fig. 1—Machined finishes on steel**

*A:* rough planed, h = 11.3; *B:* smooth planed, h = 2.8. *C:* milled (straight tooth cutter), h = 1.85. *D:* milled (spiral tooth cutter), h = 0.55. *E:* rough turned, h = 18.5. *F:* smooth turned, h = 3.55. *G:* rough faced, h = 24.5. *H:* smooth faced, h = 5.63. Vertical scale: *A*, 217; *B*, *C*, *D*, *F* and *H*, 455; *E* and *G:* 152 to 1

Dr. Kiesewetter observes that no conclusions should be drawn from the appearance of the surface curves as to possible improvements of the respective methods of surface finishing, the number of cases investigated being too small for giving a reliable basis in this respect. He also says that the purpose of his study was not to arrive at conclusions of this kind but to demonstrate the suitability of the needle method for recording the nature of the surface.

The several machine finishes were applied to test samples made of steel with a tensile strength of 45 kg. per sq.mm. or about 64,000 lb. per sq.in. In order to prevent the results of the tests from being influenced by scratches not originating from the surface finishing process under investigation, all test samples were ground first.

The investigation made by Dr. Kiesewetter is much more comprehensive, both in regard to number of cases studied and to the digesting of the results, than the limited scope of the present article permits to indicate. Some of Dr. Kiesewetter's comments on the several cases reproduced in the illustrations are given below.

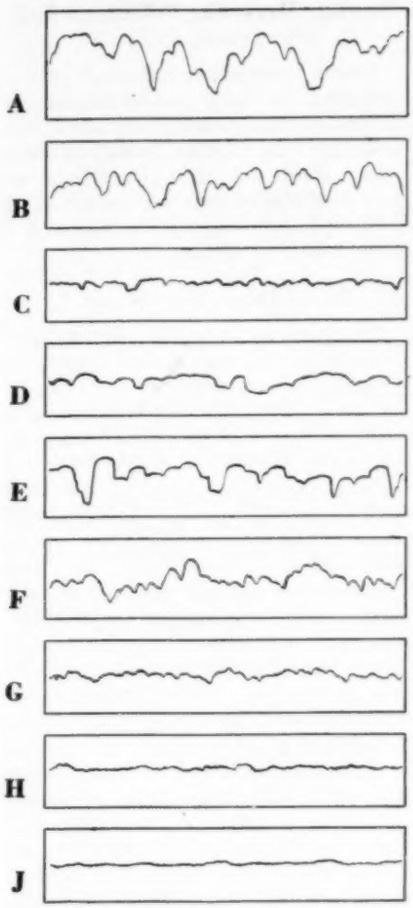
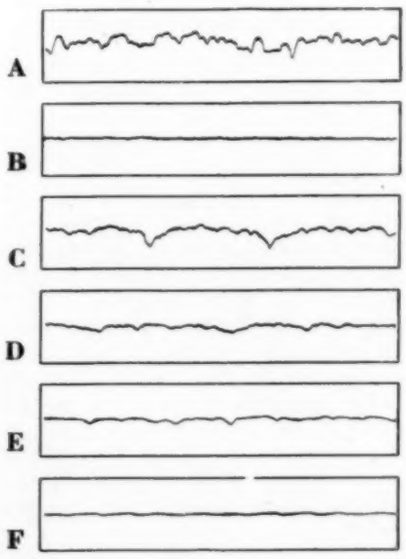



**Fig. 2—Machined finishes on steel**
*A* to *C:* finishes with machine-cut files. *A:* rough file, h = 4.45. *B:* coarse file, h = 2.75. *C:* dead smooth file, h = 0.59. *D:* finished with milled bastard file, curved teeth, h = 1.5. *E:* finished with milled smooth file, straight teeth, h = 2.4. *F* to *J:* finished with emery cloth. *F:* coarse grain, h = 1.85. *G:* medium grain, h = 1.14. *H:* fine grain, h = 0.52. *J:* polished, h = 0.28. Vertical scale: 455 to 1, for all curves.




## Turning, Facing, Planing, and Milling (Fig. 1)

The distance between the valleys or the peaks of a turned or planed surface is determined by the feed. The peaks often show two indentations, while the valleys and the flanks of the hills are always distinctly roughened because of metal chips being torn off or jammed. In the case of the milled surfaces, it is interesting to note the considerably smoother finish obtained, under otherwise identical conditions, with a spiral tooth cutter as compared with a straight tooth cutter.

## Filing and Polishing (Fig. 2)

Diagrams *A*, *B*, and *C* (Fig. 2) represent surfaces finished with machine-cut files. The effect of the difference in coarseness of the files is clearly visible. The curves of diagrams *D* and *E* (Fig. 2) were obtained from surfaces finished with milled files. Because of the larger size of the teeth of machine-cut files, the material finished with the latter is more strongly torn. As a result, a machine-cut "second-cut" or "smooth" file may produce a surface with unevennesses greater than those of surfaces finished with a milled bastard file. The curves in diagrams *F* to *J* (Fig. 2) show the results of polishing with abrasive cloths of different grain sizes.

## Cylindrical and Surface Grinding, Scraping and Lapping (Fig. 3)

Curves *C* and *D* (Fig. 3) clearly show the influence of grain size of the grinding wheel and of the feed of the grinding machine. Fine grain and slow feed result in smaller unevennesses. In diagrams *A* and *B* (Fig. 3) representing portions of ground cylindrical surfaces, the influence of the grain size is pronounced. The cylindrical grinder has given a smooth surface, while the unevennesses obtained by surface grinding were larger, but Dr. Kiesewetter observes that this result should not be generalized without further investigation.

## Broaching, Drilling, Reaming, and Pressfinish (Fig. 4)

Particularly interesting here is the difference in finish obtained with a new sharp reamer and with a worn dull reamer, diameter 21 mm. (about 0.83 in.) as shown in diagrams *D* and *E* (Fig. 4) respectively.

**Fig. 3—Machined finishes on steel**
*A* and *B:* cylindrical grinding. *A:* coarse grain, h = 1.26. *B:* fine grain. *C* and *D:* surface grinding. *C:* coarse grain, h = 0.79. *D:* fine grain, h = 0.63. *E:* scraped, h = 0.87. *F:* lapped. Vertical scale: 455 to 1, for all curves.

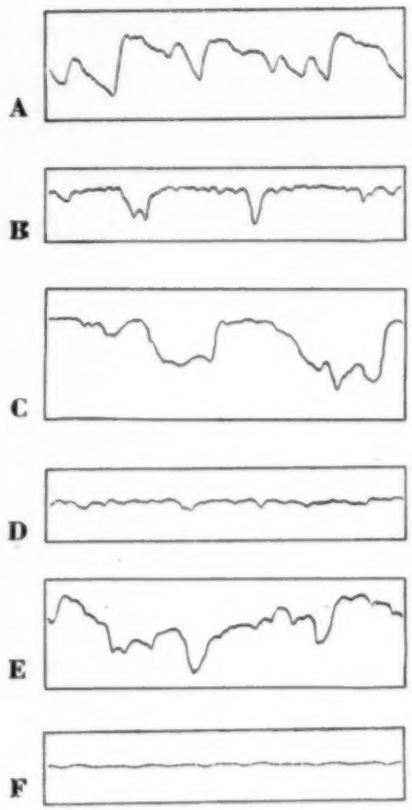



**Fig. 4—Machined finishes on steel**
*A:* broached, h = 4.14. *B:* drilled (5 mm.), h = 2.68. *C:* drilled (20 mm.), h = 9.9. *D:* reamed, sharp reamer, h = 0.63. *E:* reamed, dull reamer, h = 3.83. *F:* pressfinished, h = 0.32. Vertical scale: *A*, *B*, *D*, *E* and *F:* 455, and *C*, 217 to 1.

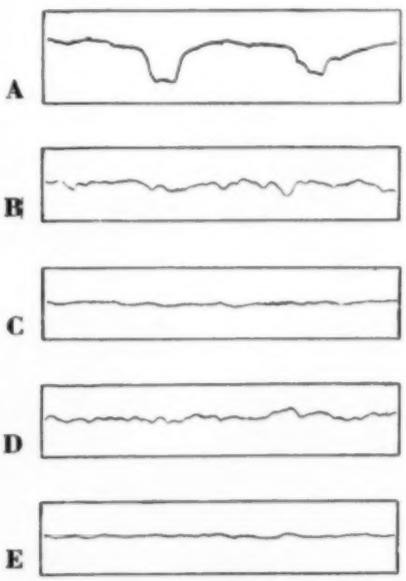



**Fig. 5—Surface qualities**
*A:* sawed steel, h = 5.3. *B:* drawn brass, h = 0.28. *C:* rolled brass, h = 0.32. *D:* drawn iron, h = 1.02. *E:* diecasting, h = 0.67. Vertical scale: *A*, 152; *B*, *C*, *D* and *E*, 455 to 1

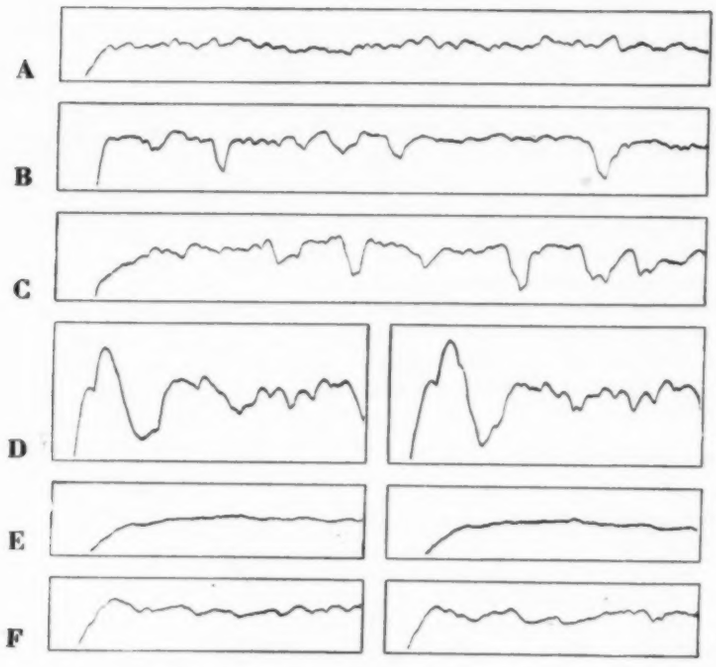



**Fig. 6—Surface quality of screw threads**

*A*, *B* and *C:* threads cut on 1-in. steel nuts. *A:* with single-point tool, h = 0.79. *B:* with cut tap, h = 1.3. *C:* with ground tap, h = 2.64. *D*, *E* and *F:* threads produced on $\frac{3}{8}$-in. iron bolts. *D:* with diehead, h = 2.88. *E:* rolled, h = 0.35. *F:* rolled, later tests, h = 0.67. Vertical scale: 455 to 1, for all curves

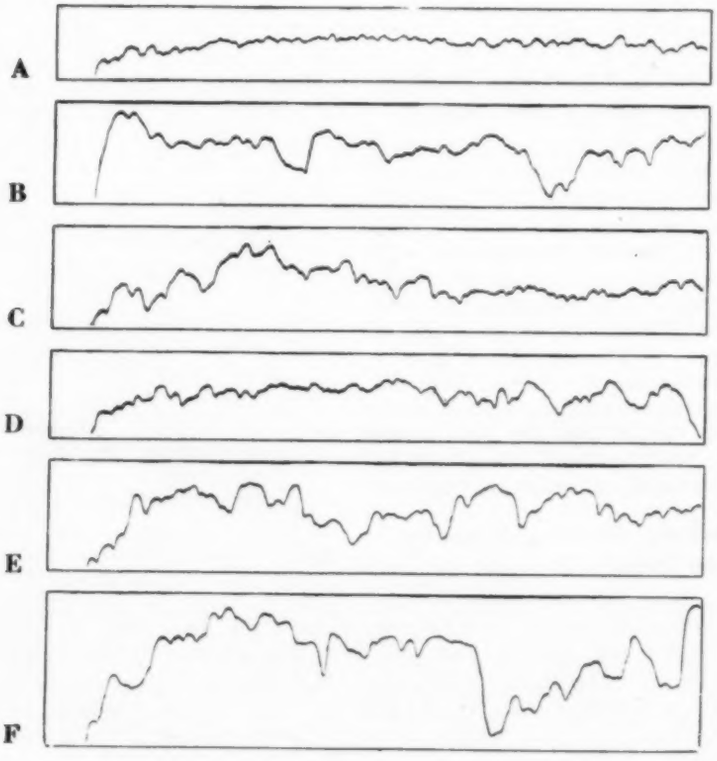



**Fig. 7—Surface quality of screw threads cut on 1-in. bolts**

*A* to *D:* thread cut on steel stock. *A:* with singlepoint tool, h = 0.95. *B:* with roughing and finishing dies, h = 2.88. *C:* with special dies, h = 1.85. *D:* with ground die-chasers, h = 1.42. *E:* cut with radial diehead on bright iron screw stock, h = 2.76. *F:* cut with radial diehead on black iron screw stock, h = 3.55. Vertical scale: 455 to 1, for all curves.

### Sawing, Drawing, Rolling, and Diecasting (Fig. 5)

Drawn brass stock, diagram *B* (Fig. 5) appeared to have much smaller unevennesses than drawn steel stock, diagram *D*. The surface quality of rolled brass sheets, diagram *C*, closely approaches that of drawn brass bar stock. Diecast parts, diagram *E*, appeared to have a smooth surface.

### Threading (Fig. 6 and 7)

Diagrams *A*, *B*, and *C* (Fig. 6) show the curves for the surface quality of internal threads, diameter one inch, cut on steel parts with different threading tools. There is a distinct difference between the thread *A* cut on the lathe with a single-point tool and the threads *B* and *C* cut with taps. Dr. Kiesewetter reports that the ground taps usually produced threads with rougher flank surfaces than did cut taps, a point that seems to call for further investigation. Six curves representing the surface quality of thread flanks of 1-in. steel and iron bolts (Fig. 7) also show that the best surface quality was obtained with a single-point tool.

Diagrams *D*, *E*, and *F* (Fig. 6) show the results of tests on $\frac{3}{8}$-in. bolts made of iron screw stock. These tests were made to determine the respective surface qualities of cut and rolled threads. The data of diagrams *E* and *F* on rolled threads were obtained by recording curves for two different spots on each of the bolts in order to eliminate the chance of hitting an exceptionally good or bad spot. The rolled threads appeared to be much cleaner than the threads cut with a diehead. Also, the threads cut on bright iron stock appeared to be better than those cut on black stock; see diagrams *E* and *F* (Fig. 7) respectively.

## Air-Operated Chucks

It is really remarkable how the use of compressed air has grown in a few short years. Its use as a means of powering machine chucks is perhaps one of the most interesting. With some companies specializing on just such work, it is not surprising that it should have reached a high state of development. We find work of many kinds being chucked without even stopping the machine; the whole thing accomplished at the mere touch of an air value lever. In addition to the various types of chucks powered by air, one has his choice of air valves operated either by foot or by hand. Where the work is such that both hands are really needed for chucking, foot valves are especially useful.

# Practical Slants on Electric Furnace Brazing

**Before and after taking examples prove the value of controlled-atmosphere copper brazing for certain jobs**

**H. M. WEBBER**
*Industrial Department,*
*General Electric Co.*

ELECTRIC furnace brazing is affording appreciable cost savings in the manufacture of several products, and has other inherent advantages which warrant its use in some cases from a quality standpoint. In passing the objects to be brazed through an electric furnace with controlled atmosphere, the copper, which has been applied near the joints, melts and is drawn into the joints by capillary attraction. This copper forms an alloy bond which is exceptionally strong, tight and clean. It is of primary importance to have all joints as tight as possible, using press fits, swaging, tack welding, riveting or any other means to hold metal-to-metal contact throughout every joint while the object is passing through the furnace.

A controlled atmosphere of hydrogen or some less expensive reducing gas is maintained in the electric furnace chamber which takes the place of the flux commonly employed with other brazing methods. This atmosphere not only cleans up light oxides on the metal surfaces, but it protects the surfaces from scaling at the high brazing temperature, thereby bringing the parts from the furnace in such clean condition that further cleaning operations are seldom necessary.

In the manufacture of the feed roll support for an automatic welding head, a cost saving of about 40 per cent has been made by substituting copper brazing for several milling operations. The part, as brazed, is shown in Fig. 1. Formerly the support was made of machine steel, cut and machined to size. The deep slot in the end was milled out, as well as the guide groove on each side and the notch in the opposite end. Two setups were necessary to round off the fingers on a bevel by milling with a radius cutter.

The support is now made by pinning pieces of standard sizes of cold rolled bar stock together and copper brazing them, which eliminates all of the milling operations but one. First, the individual parts are sawed to length and jig drilled. A number of the long fingers are then stacked on end and set up in a row for the milling of the radius. The short fingers are also milled together in the same manner. This is the only machining done on the parts. The surfaces of the pieces which come in contact in the assembly are then touched to a flat wheel to grind off the rolling skin on the steel. Clean surfaces within the joints allow the copper to wet the steel and be drawn in by capillary attraction.

The parts are then put together in the proper order and three pins are driven in with body tight fit and slightly burred on the ends to hold the assembly tight as it goes through the furnace. Note in Fig. 1 that the shapes of the pieces thus assembled are such as to leave a slot in the end, the guide grooves, on the sides, and the notch in the opposite end. These features do away with the need of milling. Copper paste is daubed on the edges and ends, and the support is then brazed.

The copper paste, which is used as a convenient means of applying copper in this instance and in several other ap-

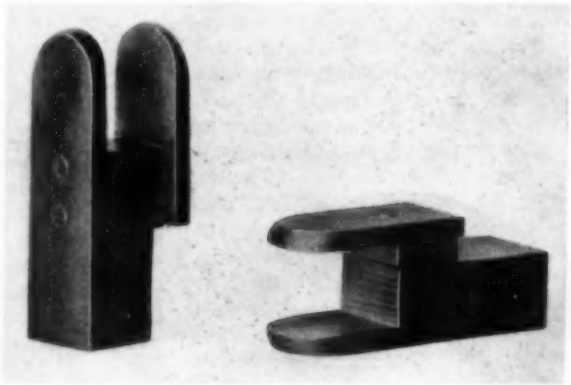


**Fig. 1 — Feed-roll support designed for electric furnace brazing to eliminate milling operations**

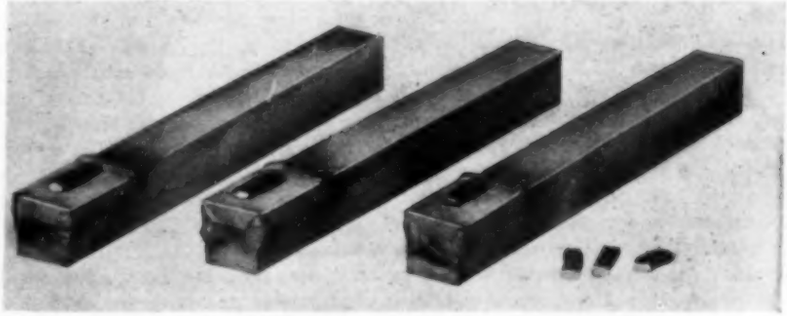


**Fig. 2—Lathe tools prepared for electric furnace brazing, by tack welding a tungsten-carbide bit into the shank and laying a copper chip on the bit**

plications, is a mixture of copper dust, pyroxylin and thinner. The liquids evaporate quickly, leaving an adhesive layer of copper on the parts where the mixture has been painted on.

Fig. 2 illustrates a tungsten-carbide bit ready to be brazed into the shank of a lathe tool. A notch has been cut in the end of the tool for the bit, and light atomic hydrogen tack welds have been made on the sides to hold the bit in place. A chip of copper laid on the bit completes the assembly. Sometimes a piece of nickel-chromium wire is wrapped around a tool of this nature to replace the tack welding. Frequently, no special precaution to fasten the bit in place is taken at all, the bit merely being pressed into its slot or groove in the tool and charged into the furnace. However, a bit so assembled is subject to being jarred out of place when the brazed charge is shifted into the cooling chamber, due to the jiggling of the tray and the slippery condition of the molten copper.

Disk saws and milling cutters tipped with tungsten-carbide-alloy inserts can be prepared for copper brazing in several interesting ways. In this application, the purpose is to fasten a block of the alloy firmly to the face of each tooth, the edges of the blocks ultimately serving as cutting edges, and the teeth in the disk merely supplying a solid backing for these cutters. Fig. 3 illustrates a milling cutter tipped with carbide, the tapered pins which lock the bits in place being still visible in the completed tool. In Fig. 4 is shown in more detail the method of preparing the tool for electric furnace brazing—by drilling small holes near the edge of the disk, indexed for the same spacing as the slots, then cutting the slots to leave only half of each hole in the face of its slot, inserting the carbide bits and then holding them in place with tapered pins driven into the holes. After brazing, the ends of the pins are ground down flush with the body and the carbide bits are ground to the proper shape, thus completing the operations on the milling cutter.

## Use of Flux Helps

Since tungsten-carbide is a little difficult to wet with copper, a small amount of flux, such as borax, oxweld or cryolite, is mixed with copper paste, and the mixture is daubed over the bits. Although the service which some of these saws and cutters are called upon to perform is sometimes very heavy, the brazed tips usually adhere well. The advantage of electric furnace brazing in this application is that several tools can be put through the furnace at one time, incurring fewer strains and less assembling expense than would be involved in a torch brazing job of the same character.

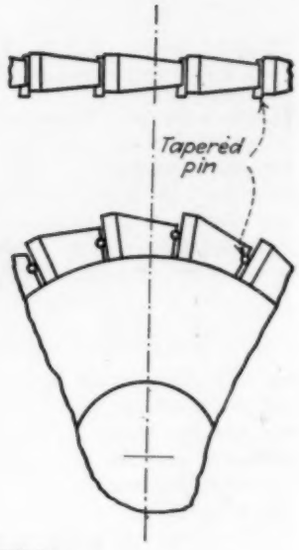



**Fig. 3—Finished milling cutter tipped with tungsten-carbide-alloy. Fig. 4—Method of holding carbide bits in place for brazing**

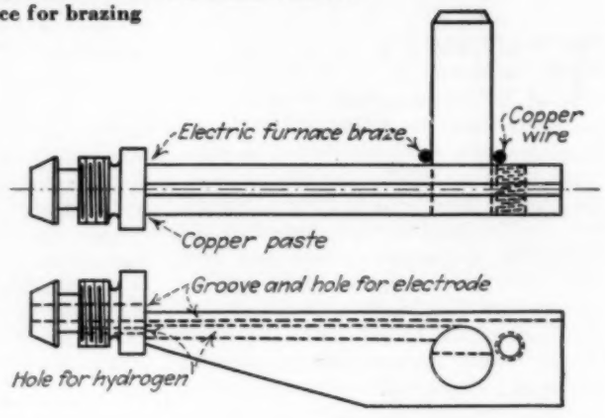



**Fig. 5 — Clamping jaw for electrode holder, with tip tack-welded to end of shank and tube pressed in a hole in the side**

Appreciable savings in the cost of making the G.E. atomic hydrogen arc welding electrode holder, have been realized by employing electric furnace brazing. The pieces made with this process are the two clamping jaws which hold the tungsten electrodes and provide a passage for the hydrogen gas to the arc between the two electrodes. One of these clamping jaws is shown in Fig. 5. The tip is a screw machine part made of drill rod and the shank is machine steel. Two holes are drilled in the tip — one for the tungsten electrode, which is in the direct center, and a smaller one for hydrogen, which is off center. A groove is cut in the edge of the shank for the electrode, and this groove must line up with the center hole of the tip. A small hole passing longitudinally through the shank for hydrogen must line up with the corresponding hole in the tip.

It was formerly the practice to set the two pieces up in a jig and weld all around the joint where they butted together, to give sufficient strength and insure against hydrogen leaks. It then became necessary to drill through the bead which had plugged the groove and center hole in the tip. In addition a filing operation was required to remove the bead from the corners of the joint adjacent to the grooves, and to smooth up the joint to improve the appearance. By eliminating these operations it was found that the cost of the piece could be reduced approximately 43 per cent. In addition, a connector is now brazed in the side of the shank at no extra expense, and it also represents a distinct improvement in design.

Under the present method of fabrication, the two pieces are properly marked with a prick-punch on the outside and are set up in a jig with a tungsten wire through the electrode hole, this wire serving to line up that hole with the groove and the prick-punched points to line up the hidden hydrogen hole. The parts are then given a light tack weld on the side opposite the groove to hold the assembly together in the brazing furnace. A small amount of copper paste is daubed around the joint, the part is placed with many others, in a copper brazing furnace, is cooled in a protective atmosphere, and comes out

clean, bright, and ready to be nickel plated and assembled in the electrode holder, since no drilling, filing or further cleaning is necessary.

An effective product for use in heat interchanging devices such as surface coolers is the spiral fin tube shown in Fig. 6. To obtain good heat transfer between the steel fin and the steel tube, an excellent advantage has been found in copper brazing the joint.

In making the fin tubing it is only necessary to set the seamless steel tube up in a machine or lathe equipped to turn the tube, tack weld the annealed cold rolled steel strip near the end of the tube, and feed the strip edgewise through a special tool as the tube is rotated.

The feeding tool travels along at a predetermined rate to give the desired pitch. At the end of travel the strip is again tack welded to the tube, then cut off. Simultaneously with winding the fin a copper wire is wound spirally along beside the fin. Preparation for copper brazing is thus completed, and it is then only a matter of passing the tube through a suitable furnace. The copper melts and flows into the joints, makes a strong uniform alloy bond between the fin and tube, and having in itself good heat conducting properties, lends itself naturally to an improvement of the product.

The thermostat frame shown in Fig. 7 is now being copper brazed to overcome difficulties formerly encountered in manufacturing, and the change has resulted not only in a better product, but also shows a minor saving in cost.

It was formerly the custom to weld the back plate to the base plate to give the rigid construction necessary, but since this joint was exposed to view on a product where appearance was a factor, it became necessary to grind and file the bead to smoothness. By substituting the furnace brazing process it was possible to eliminate the bead with its characteristic uneven surface. In addition, the localized heating frequently warped the back plate and necessitated a straightening operation, which was eliminated with the uniform heating obtained in electric furnace brazing. The studs and block in the base plate were formerly plug welded in place. The stud near the top of the back plate was peened in, which was unsightly and frequently resulted in the studs working loose.

Welding is still used to a minor degree in the assembly of this piece for tacking the parts in place, but now all of the joints are electric furnace brazed. First, the base and back plate are jig drilled. Then the two plates are set up in a jig and tack welded. The block is then plug welded to the base through a hole in the bottom plate. The studs, being screw machine parts machined to a press fit, are forced into the base and back plate, copper wire rings are placed around all the joints, and the assembly is ready to be brazed. A load of the parts is passed through a copper brazing furnace, and when they come out the parts are undistorted, and the only necessary cleaning operation is the grinding of the tack welds which are in a location that appears prominently in the finished product. In this manner, therefore, several manufacturing difficulties are overcome, and the appearance of the product is improved by the simple operation of electric furnace brazing.

Small steel containers for transporting gas under pressure are being manufactured in regular production by the same process. Fig. 8 shows one of these bottles in section, prepared for brazing, the dimensions being about 4 in. O.D. by 8 in. high.

The top and bottom caps are drawn from deep drawing steel, and are afterwards washed to remove the drawing compound. Next they are sheared, and a hole is punched and flattened in the top cap. The valve body, which is a screw machine part, is then pressed into this hole and peened tightly in place. In addition, to being strong and tight, such a joint is economical because such close tolerances need not be held on the hole and bushing as would be required for a press fit.

The two caps are then pressed over a piece of pickled seamless steel, tubing, as shown. During assembly a copper wire ring is inserted inside at the top to supply copper for the joint between the upper cap and the tube. After assembly, a copper wire is wrapped and twisted around the joint at the bottom, and a wire is dropped over the valve body at the top. When these wires melt, they flow through the joints and leave fillets as shown in the lower half of the illustration.

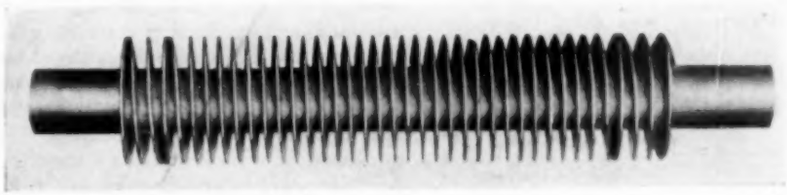


**Fig. 6—All-steel spiral fin tubing, made of edgewise-wound steel strip on a seamless steel tube, electric furnace brazed**

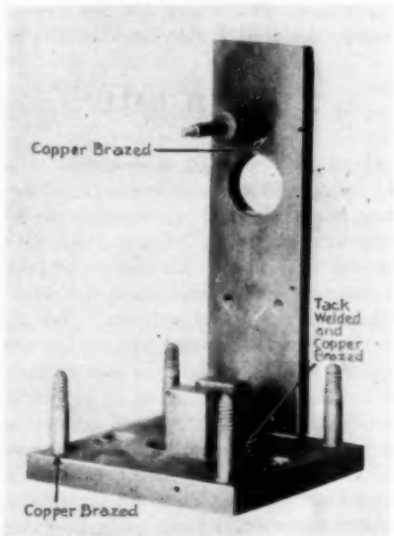



**Fig. 7—Thermostat frame, with seven joints copper brazed in one passage through an electric furnace**

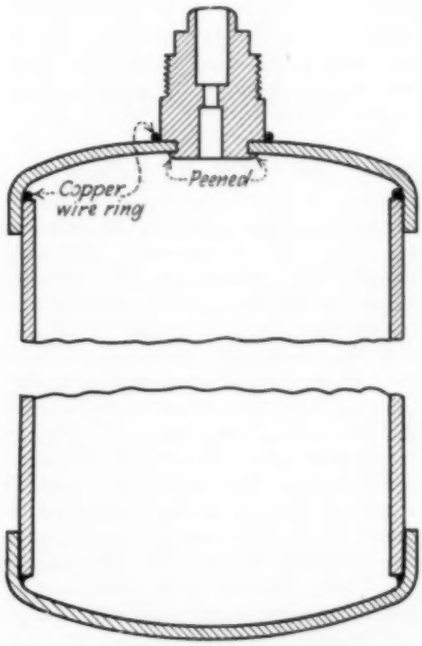



**Fig. 8 — Pressure container for gases, prepared for electric furnace brazing with copper wire rings in place near the joints, (upper half). Observe the fillets where the copper has flowed through the joints and collected in the lower corners, (lower half)**

# Accuracy With Calipers

## *Discussion*

### WILLIAM S. ROWELL

HAVING read E. Chat Shanks' interesting and able contribution to the above subject, I am moved to the following comments:

Reading a scale to plus or minus 0.002 in. or less, requires: first, an accurate scale; second, the surface or corner to be matched to the line on the scale must lie fairly close to the scale. Good mechanics have known for a generation that measurements to such limits can be made with calipers and scale when the required size falls within the width of the line, and something near these limits when the size does not. This has been better known ever since the micrometer came into machine shops and gave machinists a fairly accurate means of checking work done with calipers.

A method used by the writer to check ability to read a scale is to turn a micrometer reading line down, open the micrometer to any random size, measure the opening with a scale, record the result and then read the micrometer to determine the amount the scale measure varies from the reading. Hundreds of such tests have shown that when the opening falls on a line of the scale, the error is usually less than plus or minus 0.002 in. When between lines, the error is rarely more than plus or minus 0.003 in. Such tests must be made with an accurate scale, and a micrometer with fairly sharp corners on its measuring surfaces.

In this connection, the question arises: How accurate are the steel scales now obtained on the market? Before me lie three steel scales of three different makes. By placing them side by side, it is easy to detect a failure of the lines to coincide exactly. The amount of variation is not easy to decide, but that it is there may be brought out clearly by the use of an ordinary jeweler's 3-in. focal length eye-glass. Probably the same glass would show variations in the graduation of two scales of the same make.

A probable source of error in measuring with caliper and scale is the effect of gravity on calipers. As an example: A shaft of 2-ft. nominal diameter is carefully calipered while in a horizontal position. Is the caliper then applied to the scale as it lies on a bench horizontally? Or is the scale held in such a position that the caliper will be as nearly vertical as when applied to the shaft? Careful men on large work follow the latter course. A recent checking of a 30-in. outside caliper of one of the most used makes, showed a change of 0.025 in. when shifted from the usual position in calipering a horizontal shaft to the position used in checking its opening by a scale lying on a bench.

All measuring tools that have any tendency to spring from the action of gravity should be checked from a standard while in the same position and with the weight supported the same as when applied to the work.

### ARTHUR RATON

As one of the not-so-old timers, but one who had the privilege of being educated in a small shop, the reference caused a few thoughts to come to the surface.

In this old shop we were paid 50 cents for bushing loose pulleys. The bronze castings were turned and bored in one chucking, the bore being left slightly larger than a free running fit on standard shafting. The outside was sized to force into the pulley bore, and the hole closed usually just enough to run quite free but with little shake. The sizing was done entirely with calipers, the inside diameter being transferred to outside calipers and vice versa.

In another shop at a later date, I once saw a man turn a cast-iron roll about 10 in. diameter, 36 in. long. The diameter was required to be within plus or minus 0.002. The 10-in. micrometers were locked up in the manager's office, and he was to be absent for several days. However, the work went along just the same. This mechanic used a new, hardened scale out of a combination set and with the aid of an eye-glass set his calipers to the size he believed correct. The job was turned and the other operations carried out before an opportunity to check was afforded. When the diameter was accurately measured it was plus 0.001 in.

On another occasion in a well-known eastern shop many years ago, I saw a toolmaker grind several dozen snap gages of considerably varying dimensions from under 0.250 in. to about 2.375 in. At that time, we had no gage blocks as we know them today. We did have precision measuring instruments. This man used a small, light pair of inside calipers which he had made himself. With these calipers, he transferred the sizes from micrometers for the grinding and left only sufficient material to permit the wheel marks to be lapped out. I believe that anyone acquainted with this class of work will agree that this meant grinding to size, using the calipers as the transfer medium to within 0.0004 in. or closer of the final finished size, which was obtained by lapping on cast iron.

Before the days of micrometers, on large printing press cylinders—and some old presses did have large ones compared with the modern design—the diameters were checked with steel tapes around the circumference. Any variation from parallel was readily discerned, sometimes to the lathe hand's discomfort. There is no doubt in my mind that, on some classes of work, sizing was being done to closer than plus or minus 0.0005 in. as a regular thing 30 years ago or more.

Micrometers were not so very common at that time in the ordinary machine shop, and yet some creditable work was being turned out by men who knew little if anything about thousandths of an inch. They did have a wonderfully developed sense of touch. Even today some places use heavy "feel" in using their mikes, and others use the discretionary "feel," if I may so describe it.

### MARTIN H. BALL

About 25 years ago, a shopmate who had long experience as a machinist became much alarmed when some of his work was about to be inspected with micrometers. It was his custom to take all measurements, while doing the work, with steel rules and calipers. To his surprise, everything was well within the required limits. In fact, he was complimented for the close sizing of his work, especially on work for drive and force fits, where he had calipered one piece and made the mating member to fit it instead of working to a given dimension.

After the checking was over, he made

the following remark: "I've been working to thousandths all my life but never knew it till now."

While the greater part of our specifications and drawings at the present day show clearly the amount of variation that is allowable, there are still many given out that are not definite, leaving much to the judgment of those doing the work. Shops engaged in a general jobbing trade have considerable difficulty in satisfying their customers that the best judgment has been used in determining the allowance for the various kinds of fitted members.

It is the practice in many shops, when a dimension is given to three decimal places, to allow a limit of 0.0005 in. plus or minus for measurements up to 12 in. and where fractions are used for dimensions to accept a steel rule measurement as satisfactory, it being usually understood that such measurement can be made within 0.005 in. Experience has proved that this can be done by the average mechanic.

For measurements over 12 in., it is usual to allow a somewhat larger limit, the amount being left to the maker's judgment. Would it not be worthwhile to the industry to adopt and name standard limits to meet such cases and afford the desired protection to both customer and maker of the product? It might be termed "A commercial limit standard for machine work."

A suggestion would be that where no limit is given in specifications or on drawings for dimensions of 12 in. and under a limit of 0.0005 in. plus or minus be allowed where decimals are used and a limit of 0.005 in. plus or minus be allowed where even or fractional dimensions are given. For dimensions over 12 in. up to and including 24 in., the limit should be increased 0.001 in. plus or minus for dimensions given in decimals, and increased 0.002 in. plus or minus for dimensions given in fractions. The same amount of limit should be added for larger dimensions at each increment of 12 in.

Thus, a dimension of 12¼ in. would carry a limit of 0.007 in. plus or minus and a dimension of 24¼ in. would carry a limit of 0.009 in. plus or minus. A 48,250 in. dimension would have a limit of 0.0035 inches.

## A Small-Shop Kink
### *Discussion*

ROBERT S. ALEXANDER
*Universal Winding Company*

Having followed with considerable interest the various discussions and suggestions evoked by Charles H. Willey's article under the title given above (*AM*—Vol. 75, page 898), I am of the opinion that under ordinary conditions the excess stock could have been removed in the milling machine by means of a slitting saw without any difficulty. With the work firmly strapped to the table and all the gibs tightened to eliminate backlash, I would place a ⅛-in. high-speed slitting saw on the arbor as close to the machine spindle as possible, so as to eliminate chatter and vibration.

Neither the saw nor the spacing collars need to be keyed to the arbor, providing one simple but important rule of cutter mounting is observed—that the cutting action of the teeth will be such that the arbor nut will be tightened by the contact of the cutter with the work, instead of being loosened. That is to say, if the arbor thread be left-hand, the saw should be mounted so as to revolve clockwise when cutting. I have known experienced machinists to mount saws and cutters opposite to this rule and when, as a natural consequence, the arbor nut worked loose, to pound on the arbor wrench with a hammer to "tighten up," thereby distorting a good arbor and wasting time and temper. With the saw properly mounted and all gibs adjusted, the cutting speed should be as high as the saw and the work will warrant. By keeping the saw liberally supplied with cutting oil and maintaining a heavy pressure on the table feed, the saw should show no tendency to dig in, and the ⅜-in. plates would be minus their 1 in. of excess stock in short order.

## Oil Furnace Capacity

GEORGE P. PEARCE

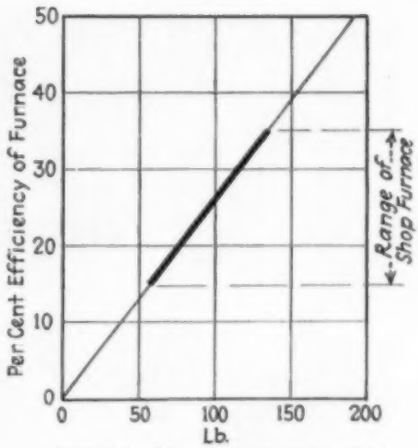
In production and cost estimating it is frequently important to have a fairly close estimate of the capacity of various oil furnaces as well as the amount of stock heated per gallon. Oil furnaces can be divided roughly into three classes:

(a) Welding furnaces working at approx. 2,900 deg. F.
(b) Forging furnaces working at approx. 2,200 deg. F.
(c) Heat-treating furnaces working at approx. 1,600 deg. F.

Stock going through these furances absorbs heat in various amounts, but it will not be far from average conditions if we estimate the heat pick-up per pound of stock as:

(a) Welding furnaces—430 B.t.u. per lb.
(b) Forging furnaces—360 B.t.u. per lb.
(c) Heat-treating furnaces — 260 B.t.u. per lb.

This heat, of course, is obtained from combustion of the oil, and the heat value of a gallon of fuel oil varies according to its composition. Probably the best




average value for this is 140,000 B.t.u. per gal. From this can be determined the output of various oil furnaces assuming they are 100 per cent efficient—which most emphatically they are not.

(a) Welding—326 lbs. per gal. at 100% efficiency.
(b) Forging—390 lbs. per gal. at 100% efficiency.
(c) Treating—540 lbs. per gal. at 100% efficiency.

Efficiency is variable not only between the furnaces themselves but the efficiency of each furnace is changing constantly according to operator, air mixture, oil, humidity and a dozen other factors. The results of a number of tests on average shop furnaces under ordinary running conditions indicate that the following efficiencies are a good approximation:

(a) Welding furnaces, approximately 15 per cent.
(b) Forging furnaces, approximately 25 per cent.
(c) Heat-treating furances, approximately 40 per cent.

We can now find about what to expect from the average furnace in pounds of stock heated per gallon of oil burned. As the hourly oil consumption per furnace is generally known by the cost department, it becomes easy to estimate production and cost by taking the following round figures:

(a) Actual welding output, 50 lbs. stock per gal.
(b) Actual forging output, 100 lbs. stock per gal.
(c) Actual treating output, 200 lbs. stock per gal.

By figuring on the basis of gallons per hour consumed, the rate and cost of stock heated may be estimated in production pounds of stock per hour.

For those who wish to get closer estimates and who are in a position to get fairly accurate data for the particular furnaces and oil being used, it is handy to draw up a chart of the type shown.

# Carbide Tooling on Existing Equipment

**WILLIAM CALKINS**
*Production Engineer, Geo. D. Roper Corporation*

**Increases in feed and speed are not the only justification for the use of carbide tools. Longer life between grinds often permits time-saving combination set-ups**

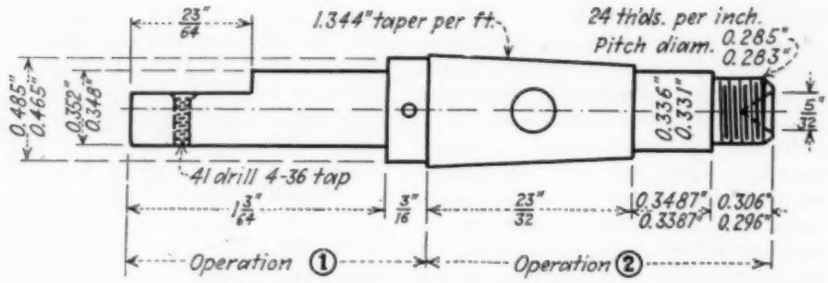



**Fig. 1—Combined operations help reduce the unit cost on this brass cock plug**

IN TIMES like these, when it is difficult to justify the expenditure of money for new machinery on the basis of present production, other means must be found for cutting costs in less spectacular ways than demonstrated by modern production tools. Much has been written about what is being accomplished through the use of cemented carbide tools. There is no question that, where the machine will stand the higher speeds and feeds recommended, the production increases are remarkable. That there are other cost-reducing benefits is not so obvious.

When the Geo. D. Roper Corporation first considered the use of cemented carbide cutters, it was felt that the only way to take advantage of the additional tool cost was by stepping up the cutting speeds and feeds. The first thought in connection with operations on hand turret lathes, for example, was to triple the spindle speed. Bringing the spindle up to 6,000 r.p.m. meant the adoption of ball bearings in place of the original sleeve bearings on what is now an obsolete model. The machine manufacturer had little to offer in the way of experience in that direction, nor were any promises made as to results. Rather than make this changeover, with its attendant cost and risk of failure, the decision was made to go ahead on the same basis as before and seek savings in other directions.•

In the Roper plant, production engineers have justified the use of carbide tools on the basis of feeds and speeds previously used with high-speed steel cutters. The question of rigidity did

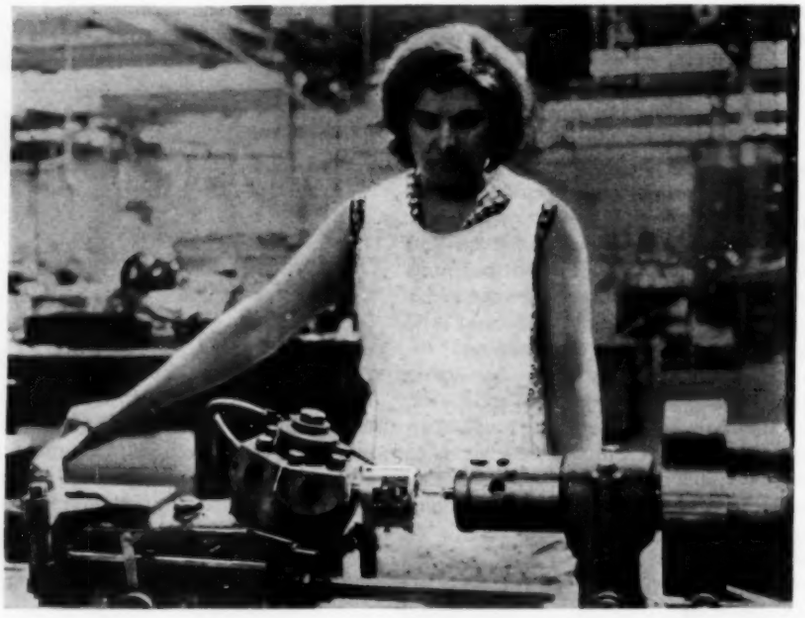
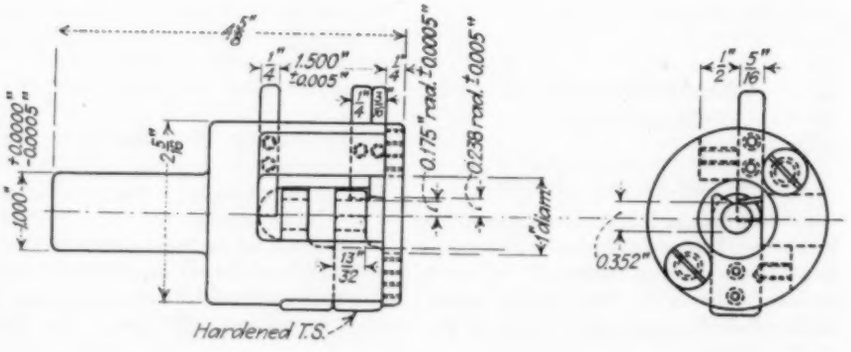


**Fig. 2—Multiple box-tools are feasible only if a reasonably long life between grinds is obtainable**



not enter. The parts are all light brass castings, and the cuts are never heavy, particularly on the hand turret lathes. Chief savings are made in the much longer tool life obtained between grinds, and this in turn has allowed the use of box-tool set-ups in which two or more operations are combined. Such tooling would not be feasible with high-speed steel, because of the extra time necessary to reset the bits in proper relation to one another after each regrind. Furthermore, since the wear life is so much longer, the parts maintain their accuracy over longer periods and need only be checked infrequently.

### Combining Operations

Some of these principles are exemplified in the manufacture of the brass cock plug, Fig. 1. Operation 1 combines facing the end, trimming two outside diameters and facing two shoulders. Three carbide-tipped bits are set up in the box tool, Fig. 2, which incorporates two hardened tool-steel guide rings to insure the accuracy of the finished cut in one pass of the tools. These guide rings resist any tendency for the work to spring and directly form a reactance bearing to resist the tool load. In the initial design, there were only two high-speed steel cutters and only one ring was employed, the facing tool not being included. When operations were combined in the cemented carbide set-up, the additional cutter with its offset load necessitated the presence of the second ring. The chief gains are saving in time from combined operations, in uninterrupted production, and the use of women operators. The production per hour remains unchanged, but the daily production has been increased as the 15-minute break-down and set-up time was a loss that occurred every two hours with the high-speed steel cutters.

Much greater savings have accrued by carbide tooling for the operations on the other end of the same plug, in which two diameters are turned, the end beveled and centered, a thread chased, and the conical part of the plug body turned. By combining all but the threading and taper turning operations in a single box tool, the piece is completed in three indexes of the hand turret lathe, Fig. 3. Thus two pieces are produced at each full index of the head. The box tools are arranged for hollow milling much as for the turning operations on the other end. The Carboloy bit for the 45-deg. chamfer is placed at 90 deg. to a pair of similar bits turning the diameters, and the 60-deg. center drill is pushed into the hollow tool shank and setscrewed in place. Because of space limitations, one guide ring must suffice. The present

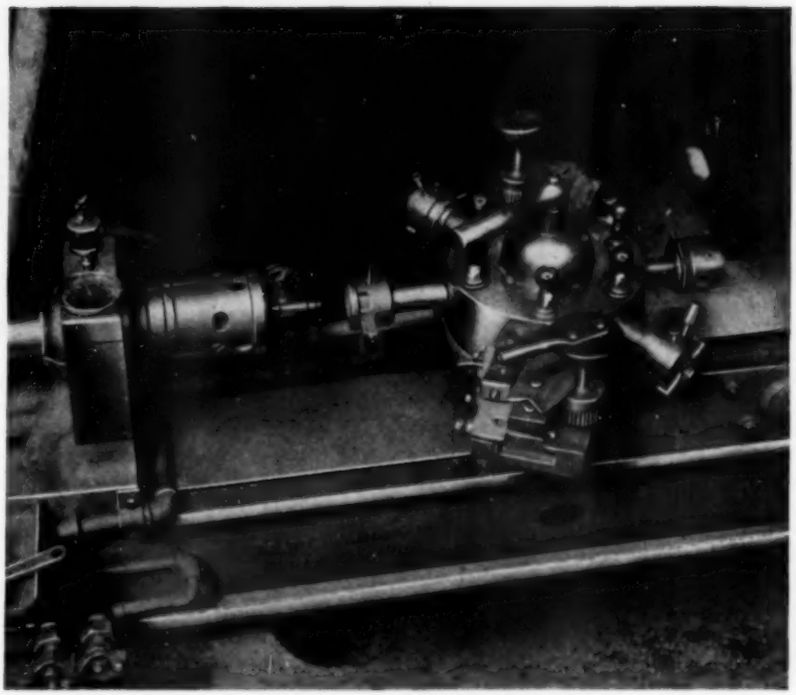


**Fig. 3—A hand fed turret is used to rough and finish turn the taper**

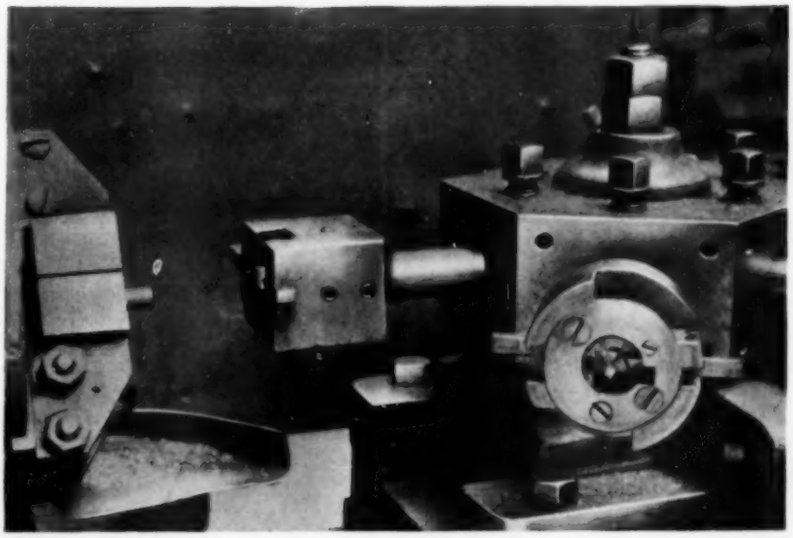
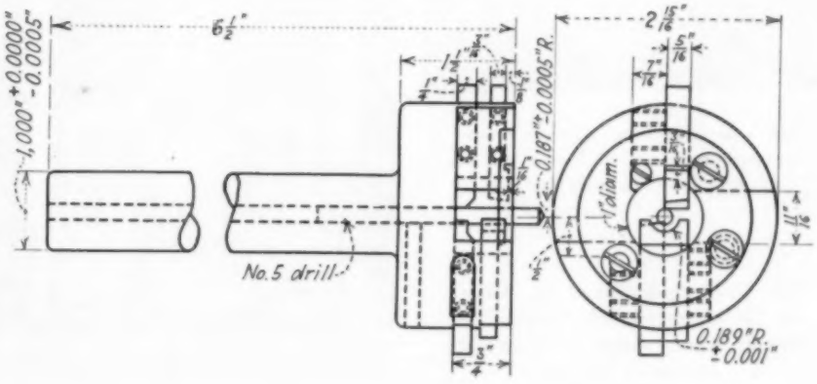


**Fig. 4—Tool bits are combined with a twist drill in another turret set-up**



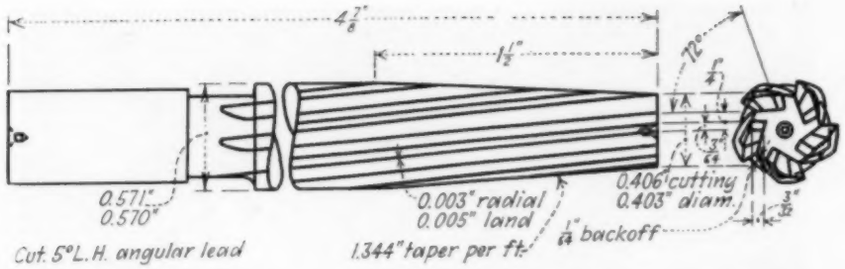



**Fig. 5—In finishing the cock body a carbide-tipped taper reamer is used**

tool combines two former operations.

Rough and finish taper turning takes place at the second station with an auxiliary hand fed tool. Formerly, these were also two separate operations. By means of a hand knob and pinion, the cutter head, carried on a slide in the tool post, is racked past the work rapidly for the rough cut and more slowly for the second, which shaves the excess material remaining from the spring in the work that takes place in the rough pass. The third station carries a self-opening diehead for threading.

Taper turning is the key operation on this plug, and accuracy is essential, particularly as regards the elimination of any barrel effect or other high spots. Finish is also important and is gained by the operator's discretion in his hand feed on the second cut. No change in spindle speed was made, but time saving was effected again by combining operations and an appreciable increase was obtained in the tool life between grinds. Where before 200 pieces between grinds was all that could be expected with 15 min. delays in set-up every two hours, the same tool performing both roughing and finishing work, in place of a single function, now finished 15,000 pieces before a regrind is necessary.

Box tools or hollow mills employing carbide bits also find use in finishing the brass cock bodies. Fig. 4 shows a set of bits combined with a No. 5 drill. Here again combinations are possible that would not be justified with high-speed steel on account of the time necessary to make the set-up after grinding as compared with the cutting time between grinds. High-speed steel cutters on some operations are changed four and five times daily.

Other operations on the cock body include a hand turret set-up in which one bore is drilled, reamed and countersunk successively. The countersinking tool is in the form of a single-blade flycutter tipped with carbide and piloted in the reamed hole. Spindle speed remains the same, and the gain is in the increased life between grinds.

Trueness of the taper seat in the body is just as important as in the plug. Fig. 5 shows the carbide-tipped finish reamer employed for this key operation. Helical in form, it has a 5-deg. left-hand angular lead to obtain the required smoothness of cut. Blades like these are built up in sections with the joints of adjacent teeth overlapped in relation to one another. For best results they are diamond lapped.

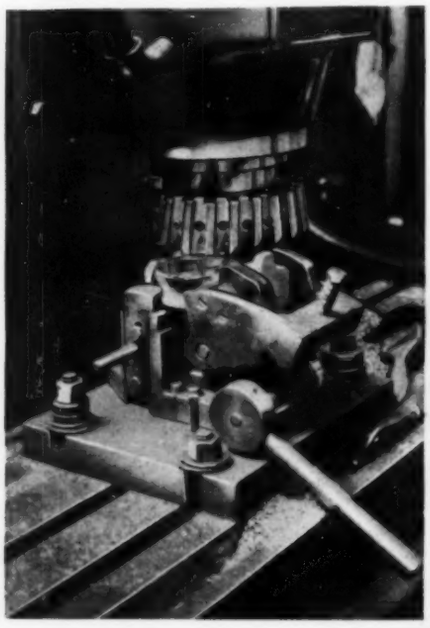


**Fig. 6—Machine feeds were stepped up to get better results from a carbide milling cutter**

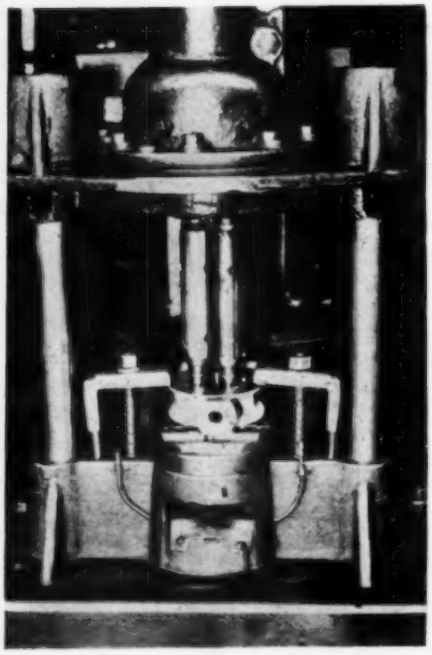


**Fig. 7—Carbide-tipped fly cutters on a close-coupled boring bar double the output with greatly increased tool life**

### Milling a Pump Body

A small brass gear pump body is another Roper part that is completely machined with cemented carbide tools. Fig. 6 shows the slab milling operations on both faces. In this instance, the original machine, which is only two years old, has been modified for carbide milling by increasing the feed range from 20 to 30 in. per min. Consideration was given to the use of the rapid traverse action as the feed for milling brass, but the idea was abandoned because the rapid traverse function was not designed to operate under a load and clutch difficulties developed. Aside from the increase in output from the faster feed, the larger gain is in the 6-to-1 increase in cutter life. An 8-in. inserted-blade cutter is shown. It need be ground only once a week on ordinary production, and this process takes 3½ hours on a universal cutter grinder. Peripheral cutting speed is 250 ft. a min. and feed 23 in. a min. for the brass pump body. The same cam-clamp fixture serves as on the high-speed steel cutter set-up.

The greatest production increase of any of the carbide applications is shown on the twin boring of these pump cases. Output is doubled in this operation—from 40 to 80 pieces per hour—by an increase in both feed and speed. Fig. 7 shows the two close-coupled flycutter bars in the special geared boring head. Each bar carries six carbide bits, three for roughing and three for finishing. Since the bores are the same as the outside diameters of the mating pump gears, interference of the cutters in these bars would result were it not for clearances cut in the bars. These clearances are flats on the bar bodies, and the two bodies rotate with respect to one another much in the same way that a pair of 3-tooth pinions would operate.

Here again the gain is twofold. Added to the advantage of reduced cutting time is the appreciable gain in cutter life. Measured in pieces per grind, the rise is from 200 pieces for high-speed steel cutters to 1,750 for the carbide cutters.

# Contour Calculations for Forming Tools—IX

**Transferring the correct contour from the drawing board to the tool requires careful control of grinding operations**

**O. A. JOHNSON**
*Chief Tool Designer*
*Tyson Roller Bearing Corporation*

WHEN dimensioning work drawings for calculated forming tools, we should be careful to provide not too many dimensions and yet enough to cover sufficiently work on the lathe, shaper, milling machine and grinding machine. There should also be sufficient dimensions for the tool checking department.

Fig. 56 shows a tool, similar to the one described in Article VI, properly dimensioned. We will first examine the lathe work. It should be emphasized that the diameters on circular forming tools must be held as close as practically possible. Some toolmakers have the idea that, if the profile of the tool is held close, the diameters may be over- or undersize. However, this is not so because, for different diameters of tool, the profile required to make the same product will vary. To obtain good results, a tolerance of not more than plus or minus 0.005 in. should be allowed on all diameters, and a tolerance of not more than plus or minus 0.0002 in. on all profile dimensions. Therefore, the tool should be made large enough in the green so that there is enough stock for removing grinding and hardening distortions. Often more time is wasted in setting up on the automatic machine a tool that was ground undersize, because not enough grinding allowance was left by the lathe hand, than would be required to grind a tool having a little more stock than necessary.

When providing for grinding stock, this allowance should be perpendicular to the center line of the tool for circular tools and perpendicular to the back of

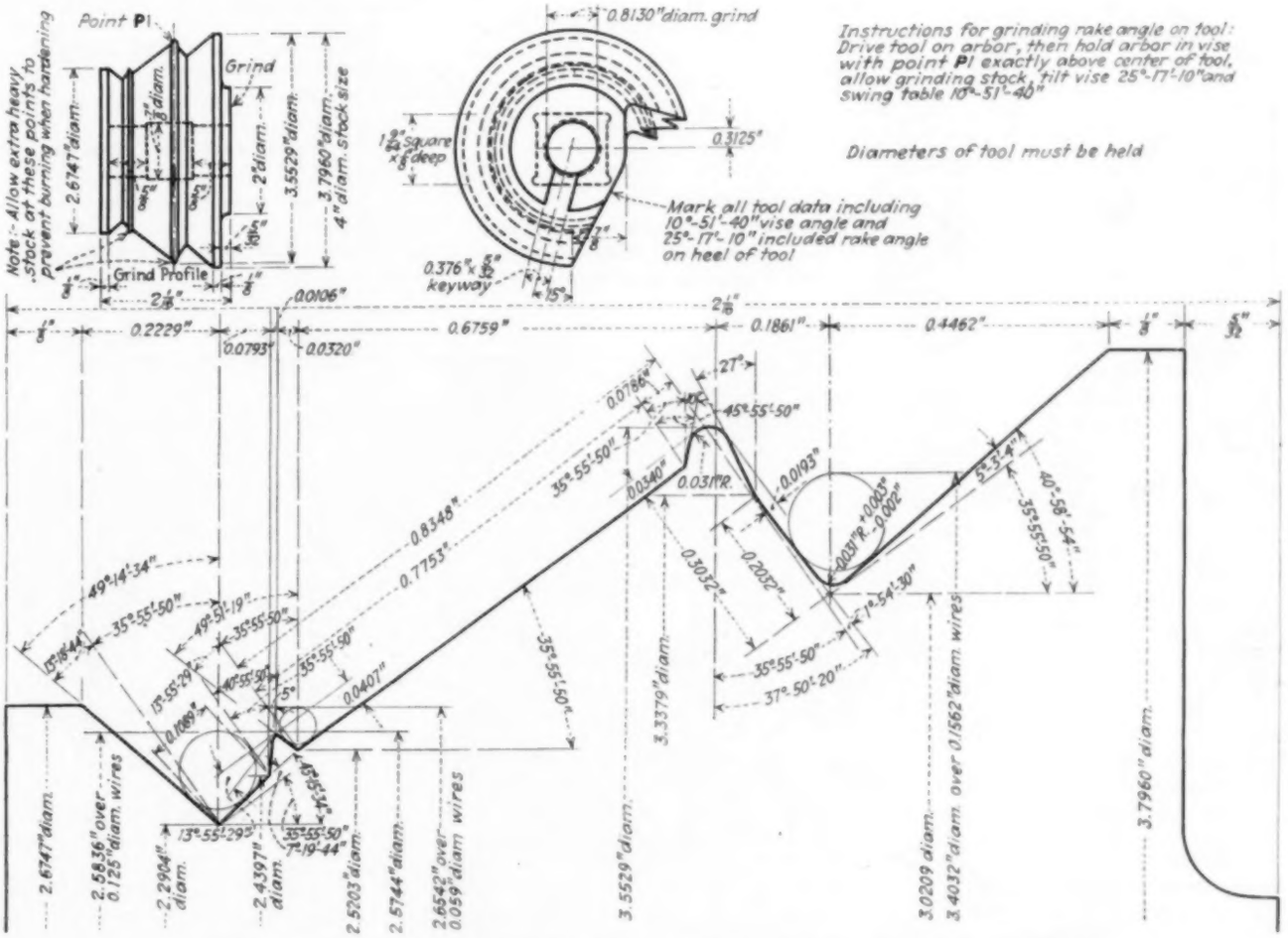
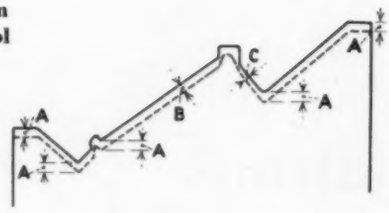



**Fig. 56—To make a drawing giving adequate information for making a tool without needless dimensions requires an understanding of each step performed in the toolroom**

Fig. 57 — Right — A grinding allowance in one direction only simplifies making the tool




A series of gages with different portions notched out are used to check the successive grinding operations

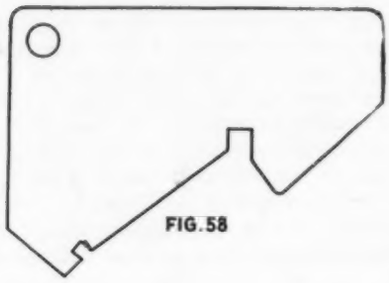


FIG. 58

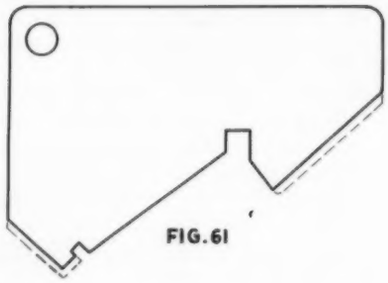


FIG. 61

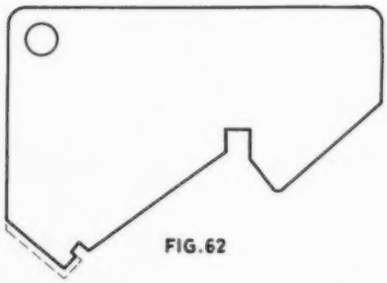


FIG. 62

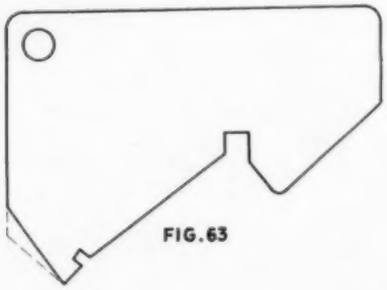


FIG. 63

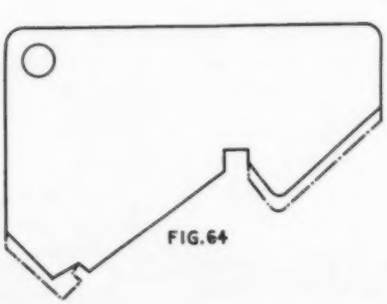


FIG. 64

flat tools as shown in Fig. 57. I have seen some toolmakers trying to give the tool a uniform grinding allowance, say for instance, 0.015 in. perpendicular to all surfaces. More time is wasted trying to do this than if the tool was made to fit the finished gage (Fig. 58) and grinding allowance added to all diameters for circular tools and all vertical dimensions for flat tools. Fig. 57 shows that if the same allowance $2A$ is provided for all diameters, the tool profile will be the same as shown on the drawing (Fig. 56). This will greatly facilitate the lathe work, as all diameters may be measured by micrometers by adding the same allowance. The grinding stock thus provided will not be uniform (see *B* and *C*, Fig. 57), but if there is a little more stock to grind off at *B*, the time lost in grinding cannot be compared to the time gained when turning the tool. The calculations necessary for the lathe man will thus be minimized to simple additions.

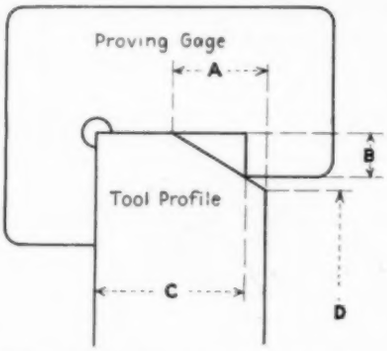



Fig. 59—Dimension *A* and diameter *D* on this tool must be held to microscopic tolerances; therefore, a proving gage must be used to check the grinding

It is always good practice to engineer all work in such a way that only simple additions or subtractions need be made in the toolroom. There may be cases where the rule described above cannot be followed, but as a rule, 0.040-in. grinding allowance on all diameters for circular tools will give sufficient stock on all surfaces, as no angle on the tool profile can be less than 8 deg. to a line perpendicular to the center line of the tool. If there are any sharp points or nibs on the tool, extra heavy stock should be provided at these points to prevent burning when hardening the tool.

There are several reasons why the contour of a calculated forming tool should be ground:

1. To eliminate inaccuracy caused by distortions in hardening
2. To obtain a good finish on the product
3. To prolong tool life (more pieces per grind)
4. As pointed out in previous articles, undercutting tools should be incorporated on the finish forming tool whenever possible. The only way to finish

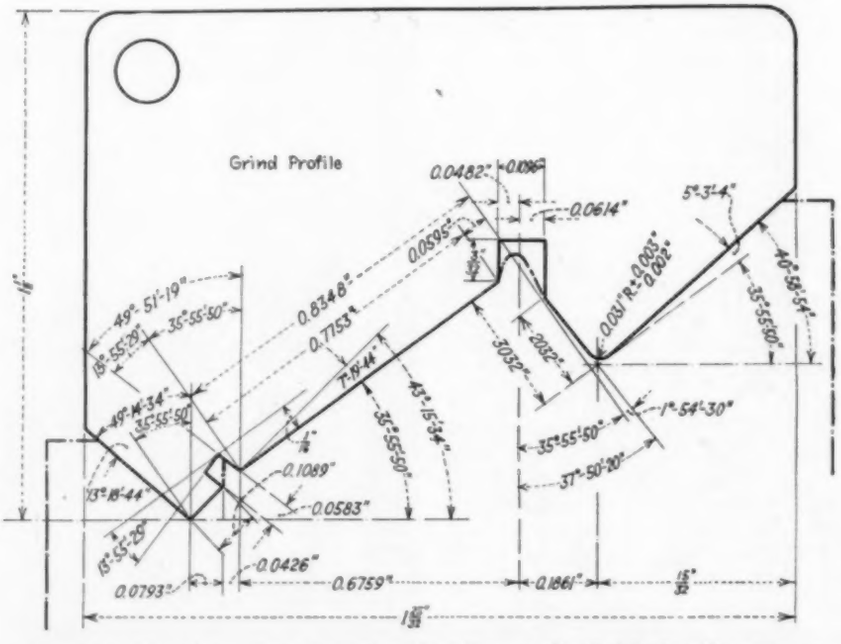



Fig. 60—The above gage is employed to inspect the finished tool contour

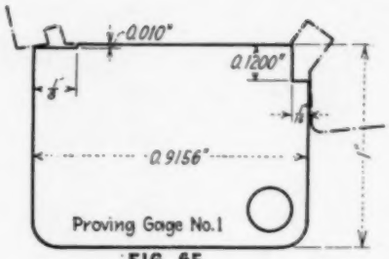



FIG. 65

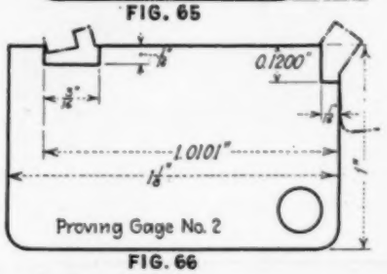



FIG. 66

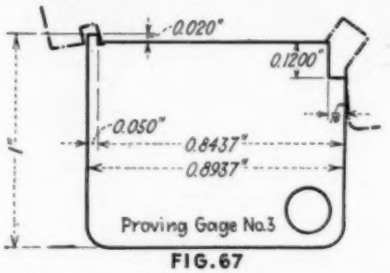



FIG. 67

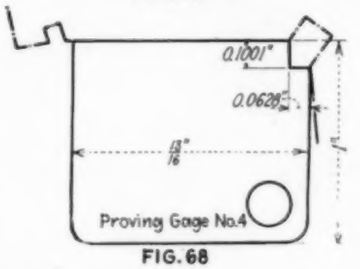


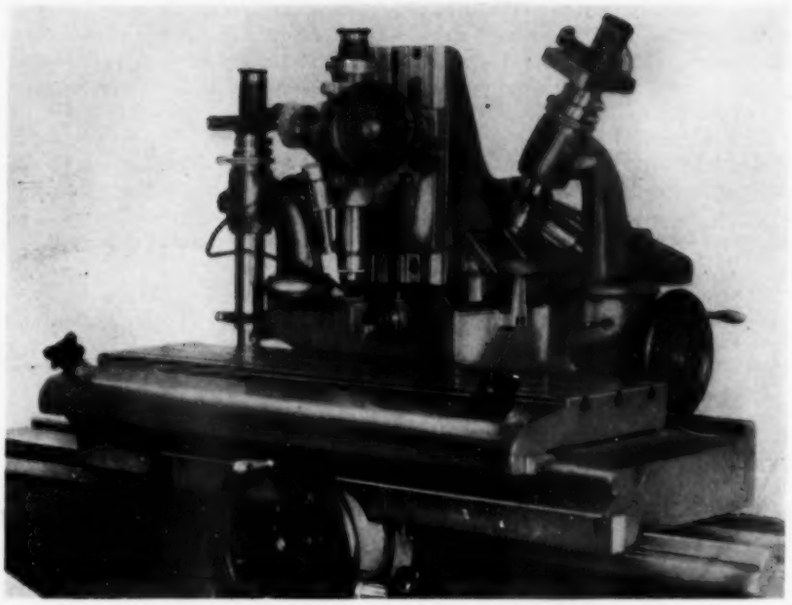

FIG. 68

**Proving gages are made to check dimensions on the profile gages that cannot be calipered**

these nibs that form the undercuts on the product is by grinding.

The writer read an interesting article "Grinding Direct from the Drawing" (*AM*—Vol. 75, page 367). Unless the tool is ground in a method similar to the one described in that article, we will have to grind the tool to fit profile gages. Our modern grinding machines are equipped for measuring the work directly on the machine. This way of measuring is satisfactory when the contour of the tool does not have to be held within microscopic tolerances, but for very close work or when we have a condition as shown in Fig. 59, tool gages should be made.

All calculated forming tools should have ground bores. The bore of the tool should be ground first and then the end or ends as the case may be. Then the tool should be driven on an arbor, which is hardened, ground and



**For precise measurements, this Société Genevoise machine has proved useful**

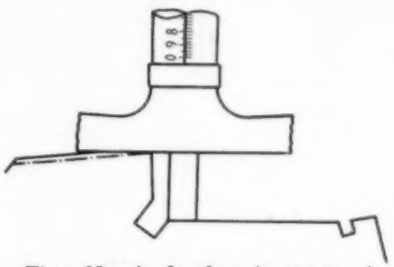


**Fig. 69—A depth micrometer is used to position one surface in the gage from another**

slightly tapered and has centers in both ends, for grinding the outside diameter of the tool.

In Fig. 60 is shown a profile gage to check the finished contour of the forming tool. These gages should be made of $\frac{1}{16}$-in. flat stock. As it is just as easy to grind several gages simultaneously, enough should be made to check to different operations in grinding as will be explained in a later paragraph. Fig. 60 is the profile gage finished by grinding. Fig. 58, 61, 62, 63 and 64 show the same gage with different portions notched away to make possible the checking of the tool profile as the tool is being ground. These gages should be riveted together before the hardening operation.

If the gage shown in Fig. 60 is not ground by the method described in the article referred to above, proving gages should be made up as shown in Fig. 65, 66, 67 and 68. Before deciding how to make these proving gages, the tool designer should know how the profile gages should be ground step by step by ordinary grinding practice.

The proper surface to grind first on the gage shown in Fig. 60, is the longest one (0.7753 in.). The gage should be held in the vise so that this edge is parallel with the traverse slide on the machine. After grinding this edge, a 1° 54′ 30″ angle should be dressed on the grinding wheel for grinding the 0.2032-in. edge. This angle is dressed by setting the wheelbase to the given angle and truing the side of the wheel with a diamond while running the wheelhead back and forth. Then the edge having the 5° 3′ 4″ angle should be ground at the same setting of the table. The 0.3032-in. dimension may be obtained by direct reading of the handwheel on the machine and may be checked by a depth micrometer as shown in Fig. 69. Then the table should be swung 5° 3′ 4″, the ground portion of this edge should be blued, and the entire edge should be ground until the blue disappears. All of these three edges may be ground without the use of any proving gages.

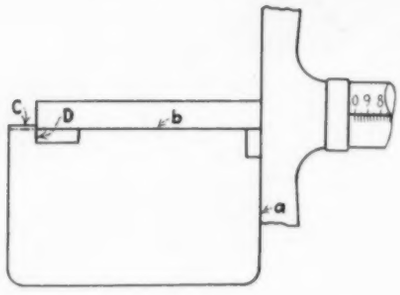
The next edge to grind would be the 0.1089-in. edge. This cannot be ground without the use of a proving gage as no direct micrometer reading can be made. A gage similar to the one shown in Fig. 65 should be made. After swinging the table 7° 19′ 44″, the 0.1089-in. edge should be ground until the gage shown in Fig. 65 fits. The important dimensions on this gage, 0.010 in., 0.9156 in., and 0.120 in. can all be measured by direct micrometer readings.

Then the table should be swung back to zero and a 13° 18′ 44″ angle should be dressed on the side of the grinding wheel. For grinding the corresponding edge, a proving gage similar to the one shown in Fig. 66, should be used. Then a 13° 55′ 29″ angle should be dressed on the grinding wheel, and for grinding this edge a gage as shown in Fig. 67 should be used. The 0.0583-in. wide groove

may be ground next and the correct size obtained by grinding a piece of flat stock to this dimension and then grinding the last side of the groove until the gage thus obtained will fit. The 0.1096-in. wide groove should be ground to fit the gage shown in Fig. 68. The radius may finally be ground after dressing the grinding wheel to the required radius, using a radius truing fixture.

At a first glance it may seem impossible to measure the gage shown in Fig. 66 with a micrometer. This is, however, easily accomplished by first grinding the edge *a* (Fig. 70), then grinding the longest edge *b* at 90 deg. to this, leaving the part *c* of the gage stick out about ¼ in. Then the important side of the groove *d* may be ground and the 1.0101 in. dimension measured by a depth micrometer. Finally, the edge *c* may be ground flush with the longest edge *b*, the last notch ground and the 0.120 in dimension measured with a depth micrometer.

**Fig. 70—Selection of the proper sequence of grinding operations makes possible the use of calipers for the gage illustrated**




All these proving gages are, of course, ground before any grinding is done on the profile gage. They have merely been explained in this order to show how they are used.

As pointed out before, it is necessary to hold the diameters of a calculated forming tool close in order to obtain good results. Therefore, when determining the starting point, a surface should be selected so that the diameter may be measured easily, either directly, or over wires. The proper surface to grind first on the tool shown in Fig. 56 would be the 0.7753 in. long surface. It should be noticed that all principal angles are given from lines parallel or perpendicular to this surface.

The taper master shown in Fig. 71 should be about the same length as the arbor that the tool is ground on. The reason for making up a taper master is to be able to reset the table exactly at the same angle if the setting of the table has to be disturbed. The taper master may also be checked in an optical instrument to an accuracy of one minute which makes it possible to hold the principal angle on the tool within microscopic accuracy to the bore, which is essential for a calculated forming tool if good results are expected.

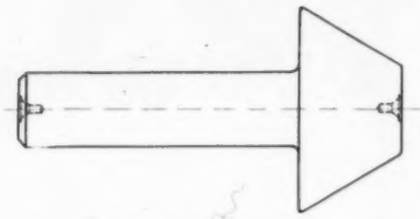


**Fig. 71—A high degree of precision in setting the grinding head is obtained through the use of a taper master**

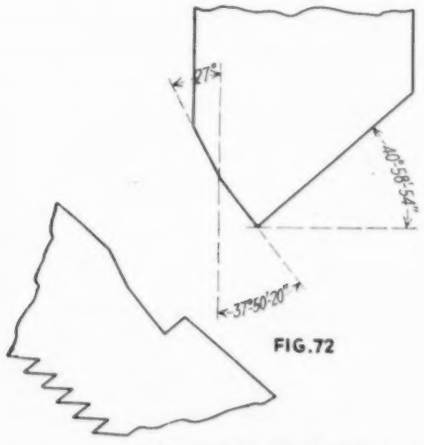



FIG.72

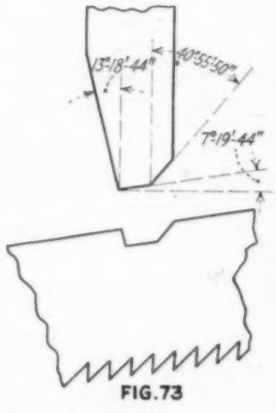



FIG.73

**Grinding wheel angles may be checked by measuring the notch produced in a hacksaw blade**

First of all, a 13° 55′ 29″ angle should be dressed on one side of the grinding wheel by setting the wheelbase to this angle and truing a portion of the side with a diamond running the wheelhead back and forth. Then a 45° 55′ 50″ angle should be dressed on the opposite side of the wheel by setting the wheelbase to this angle. Next the wheelhead should be swung back to zero, the taper master should be put in the machine on centers and the table swung around until a dial indicator fastened to the T-slot on the wheelhead registers zero when run along the tapered surface of the taper master. Then the tool should be put in the machine and the longest edge ground. Before taking the finishing cut, all angles on the wheel should be retrued. The gage shown in Fig. 64 should be used for checking the length of this surface.

Next the grinding wheel should be dressed as shown in Fig. 72. The 0.2032-in. edge may be checked by running a discarded hacksaw blade against the wheel and checking it in an optical instrument. The edge having the 40° 58′ 54″ angle should be trued back until the 0.2032-in. edge of the wheel is about 0.002 in. undersize. Then a 0.031-in. radius should be dressed with a radius truing fixture. Now the wheel is ready for use.

The table should be swung back to zero and the 0.2032-in. surface and the surface having the 27-deg. angle should be ground until the gage shown in Fig. 61 fits. Then the adjacent surface should be ground until the gage shown in Fig. 62 fits. Then the wheelbase should be swung to a 7° 19′ 44″ angle, and the wheel should be trued to this angle with a diamond while running the traverse slide back and forth. A 13° 18′ 44″ angle should be dressed on one side and a 40° 55′ 50″ angle on the other side.

The 0.1089-in. dimension may be obtained as explained above (see Fig. 73). The width of this wheel at the outside periphery should also be 0.002 in. less than the desired dimension on the tool. Then the 0.1089-in. surface and the surface having the 40° 55′ 50″ angle should be ground, after swinging the table back to the original angle of 35° 55′ 50″, until the gage shown in Fig. 63 fits. The adjacent surface should then be ground until the gage shown in Fig 58 fits. The top of the rib having the 13° 55′ 29″ angle should be ground until it measures 0.0407 in. Finally, the 0.031-in. radius is ground by a concave grinding wheel dressed to this radius.

The 2.2904-in. diameter, 2.5203-in. diameter and the 3.0209-in. diameter may all be checked by measuring over wires.

Some of the dimensions shown on the tool profile and profile gage would be impossible to use by direct micrometer readings. These dimensions are put on the drawing for the checking department. A calculated forming tool having an intricate profile cannot be checked efficiently without the use of an optical measuring instrument. A measuring instrument to be recommended for this type of work is illustrated.

# EDITORIALS

AMERICAN MACHINIST
VOLUME 76 ESTABLISHED 1877 NUMBER 36
McGRAW-HILL PUBLISHING COMPANY, INC.
K. H. CONDIT F. H. COLVIN
EDITORS

## Two Ways of Providing Immediate Unemployment Relief

If Congress really wants to provide jobs this winter for men out of work, no quicker way to do it exists than to appropriate funds for re-equipping government arsenals and navy yards, and to authorize the placing of educational munition orders with private manufacturers. We have no doubt that every Congressman wants to do his utmost for unemployed voters, but we do question his understanding of the manufacturing problems involved in munition making. Much of the arsenal and navy yard equipment is of historical rather than practical value.

Generally speaking, the ordering of new machine tools or other production equipment for the arsenals and navy yards means immediate work for men in the equipment building shops. In most of these plants inventories of finished machines are not large. In those that have inventories the chances are that the executives would be willing to start new lots through if their inventories were reduced by orders.

The beauty of this type of constructive, job-producing relief is that it would put men back at work overnight. Most of the R.F.C. projects have led to actual jobs only after months of pulling and hauling, and more or less necessary preliminary work. The exceptions have been the railroad repair work loans which have operated much as the appropriations we are suggesting here would operate. A factory job differs from a construction job in that all the facilities are at hand and the only move that has to be made is to call the men back to work.

In past issues of *American Machinist* we have stated the case for the educational munition order exhaustively. When it was first discussed it was advocated solely on its unquestioned merit as a means of national defense. Last winter it was put forward as an unemployment relief project, and we now advance it once more on that same basis.

Restated briefly, the proposal is to permit the Secretary of War to place small trial orders, for things needed by the Ordnance Department, with private firms that would undoubtedly be called on to make these things in an emergency. Two steps are necessary to get this project started: legislation authorization for the Secretary of War to disregard the statute that requires competitive bidding, and appropriations to cover the cost.

The authorizing legislation is simple and logical. It only failed of passage in a previous Congress because a disgruntled "progressive" representative refused unanimous consent. The appropriations need not be very large to provide a good many jobs because they can be spent very largely for labor and engineering service.

We respectfully urge these two means of making work on Congress as being immediate in their effect and good business from the point of view of national defense. And we suggest to heads of equipment and metal-working plants the desirability of discussing these proposals with their own Congressmen.

## End of the Chicago Plan

Another intelligent effort to conduct business on a basis consistent with current conditions ends with the announcement by the Federal Trade Commission that Chicago machine tool distributors must abandon the Chicago plan. It is a pity that the Commission found it necessary to follow the letter of the law in stopping a practice that had pretty nearly eliminated the worst phases of the trade-in evil.

Quite possibly the members of the Commission felt that they had no discretion in a matter of strict legal interpretation. If so, then we have one more piece of evidence to prove that the Sherman anti-trust law does not always function as its sponsors intended, and that it therefore stands in need of modernization.

## We Have a Birthday

Fifty-five years ago this month the first number of *American Machinist* was started on its way to the metal-working industry. More than two thousand subsequent issues have been published since then. We are proud of that record and we hope to extend it far into the future.

Fifty-five years is a long time, yet there is one man on the staff who was active in the industry before the paper was introduced. He demonstrated a planer at the Centennial Exposition in 1876. If your arithmetic is good you will have figured out that that was one year earlier than our inception as a paper.

Fifty-five years of ups and downs in the business and industrial world, of panics and booms, of depression and prosperity. Yet, withal, our own industry has forged steadily ahead, playing a major part in the advancement of civilization through its contributions to the relief of men and women from needless exertion. Some of our critics hold us of the machinery trades largely responsible for the ills of the present, the unemployment that is the curse of our inability to adapt advanced engineering technique to a system of

economics that is still tied to a doctrine of value based on scarcity, and to a legal code that is a century and a half old. It has even been suggested that a halt be called to the progress of physical science until economics and sociology can catch up. That, of course, is an impossibility. Human ingenuity cannot be bottled up for long without causing an explosion that would wreck our world. We suggest, on the contrary, that those who are to instruct us in the improvement of other phases of human activity and relationships redouble their efforts to catch up with the procession, and thus enable us to foresee and forestall another such catastrophe as the one from which we are just struggling to recover.

Fifty-five years of active association with an industry rates some sort of a celebration, but times are such this year that we are not giving a birthday party. We shall confine our observance of the anniversary to this brief editorial, and end it by insisting that in spite of our years we feel younger than ever and honestly hopeful of what the near future holds for the industry and for *American Machinist*.

## • CHIPS •

Democrats swept into power by wave (rather wet) of popular dissatisfaction with things as they are . . . Business accepts the change philosophically and hails the relief from politics . . . speculates on cabinet appointments . . . prepares to continue efforts to emerge from depression . . . Talk of manufacturers' sales tax and beer bills spreads . . . Tariff tinkering unlikely before 1934.

Textile industry operating at practically normal rate, says *Textile World* . . . but manufacturers have not yet plucked up enough courage to sell at profitable prices . . . Carloadings decrease seasonally . . . Electric power output also off . . . More buyers attend Jamestown furniture mart than came last year . . . Steel backlog rises for third consecutive month . . . Baldwin Locomotive bookings gain . . . Contracts awarded for Golden Gate Bridge . . . Roebling gets cable contract . . . Plymouth 6 announced . . . Chevrolet 6 statement to come early in December . . . Dodge 6 also due shortly . . . A. T. & T. declares regular dividend . . . Chicago consulting engineer reports more business since September 1 than in the previous two years . . . Failures in week of November 10 set low mark of year.

Nazis lose 30 seats in German election . . . Von Papen cabinet, failing party support, resigns . . . Geneva, peace capital, stages a riot . . . Hurricane kills 1,000 in Cuba, wipes out whole towns . . . British ambassador's request for reconsideration of debt terms followed by similar requests from other Allied debtors . . . Hoover and Roosevelt discuss the question informally . . . Intergovernmental Debt Committee of leading American economists urges Congressional consideration . . . Japanese bankers object to big army bills in new budget . . . cabinet crisis threatens . . . France, Britain and Germany unite in plan to electrify railroads in Poland, Roumania, Portugal and Irak . . . $666,400,000 loan to be floated . . . work for idle involved . . . Soviet threatens to withhold food cards of inefficient workers . . . Amtorg denies rumor that it will close offices here . . . paid out nearly $10,000,000 in first half of November on agricultural implement contracts . . . India conference begins in London.

Railroad heads hold annual meeting to discuss wages, credit, economy measures . . . Coolidge says his committee will not report on transportation troubles for two months . . . Lamont tells N. Y. U. economic conference panic is over . . . Sir Arthur Salter says individual competition needs supplementing by collective planning . . . National Association of Manufacturers deplores government competition with private industry . . . hears Archie Roosevelt state that veterans' widows will demand aid until 2015 . . . and that total cost of relief will be nearly $90,000,000,000 . . . Three A. F. of L. groups, building trades, metal trades, label trades, recommend aggressive action for 6-hour day, 5-day week, same wage . . . Commerce Department will supervise projected flights abroad hereafter . . . must approve both plane and pilot.

Bond pool distributes 1½ per cent semi-annual payment on its debentures . . . earnings believed to be double this amount . . . Chrysler reduces depreciation rates on most classifications of property . . . from 12 to 10 per cent on machinery . . . Procter & Gamble office goes on 5-day week, following similar arrangement in works . . . Canada starts transcontinental chain of landing fields to occupy 2,000 idle . . . Standard Oil of N. J. adds 2,000 men and saves jobs for many usually laid off at this season, by adoption of 5-day week . . . October employment in New York State factories increased for first time in three years . . . G.E. reports re-employment of 2,500 men for manufacturing sales and installation work on new oil burner . . . A. P. Sloan, Jr., gives dinner in New York to promote spread-work movement . . . Teagle and Young advocate and explain it . . . Four Wheel Drive Auto Co. adopts 5-day week . . . Three Chevrolet plants in Flint, Saginaw and Bay City reach full-payroll operation . . . Employment increases at plants of Chrysler Corp. as new models approach production . . . Graham-Paige places materials orders totaling $1,500,000.

Prices of copper, zinc and tin advance . . .lead price holds previous gain . . . chemicals show no change from October . . . steel prices steady, output maintained.

## "Chicago Plan" Called Illegal

An order by the Federal Trade Commission has declared the Chicago Appraisal Plan, adopted by machine tool distributors in the Chicago District in 1928, to have "the purpose and object of eliminating competitive bidding by its members and to limit the amounts allowed by them for used machinery." The distributors who have operated under this plan have been ordered to stop its use and to desist from the adoption of any other plan whereby members suppress or restrict competition between themselves in bidding for or appraising used machinery offered as part payment for new machinery.

Under the Chicago Plan, members agreed to register with a central agency every bid made for a "turn in." The amount of this bid but not the name of the bidder was made available to every member upon inquiry. Further, the member making the first or highest appraisal had to be prepared to accept or purchase the used machinery. The plan completely eliminated reliance on used machine bids as a means of cutting prices.

The plan was devised to eliminate some of the oldest evils in the machinery business: first the jockeying of opposing bids for old machines between competing dealers often sustained by information from the buyer, not necessarily true; second, the making of a ridiculously high offer to spoil a competitor's sale and then backing out of the deal.

## Industrial Problems Before New England Council

Industrialists assembled at the Eighth New England Conference held in Boston November 17-18 were addressed by Ralph E. Flanders, vice-president of the Jones and Lamson Machine Co. and vice-chairman of the Industrial Rehabilitation Committee of the First Federal Reserve District. Mr. Flanders said, "Equipment and construction industries in general take the major impact of a depression and initiate revival. Conditions are now ripe for that movement."

The Share-the-Work Movement was presented by L. C. Walker, national vice-chairman of this activity. "Relief, charity and the dole cannot continue to take the place of honest work without very serious consequences to the unemployed themselves and to society as a whole," stated Mr. Walker in a plea for the wider distribution of available work.

R. H. Whitehead, president of the New Haven Clock Co., advanced a substitute tax plan to avoid the drawbacks of the present Federal excise levies. The basis is a "tax on value added by manufacture" whereby a levy would be made on the difference between gross and net purchases and gross and net sales.

## New Products to Appear at Power Show

Three hundred manufacturers of power and mechanical equipment will exhibit their latest designs at the 10th National Exposition of Power and Mechanical Engineering to be held in New York, December 5-10. Among the distinctly new devices will be a three-element water level control; a new type of temperature control, designed to eliminate hunting; a differential draft-control system; a device for controlling the fuel level in ball mills; and a new mechanical steam flow system. Two new types of expansion joints will be shown for the first time.

Many valves and fittings of alloy steel will reflect the result of research to meet conditions imposed by the trend toward higher steam pressures and temperatures. Recent progress in welding will be depicted by the display of welded and fusion-welded boiler drums.

An educational display of timely interest will deal with atmospheric pollution. This will treat the subject from several angles such as economic aspect, methods of measurement, effect on the human system, research and progress in abatement. Cooperating in this display are the N. Y. City Dept. of Health, the Mellon Institute, the N. Y. Meteorological Observatory of the U. S. Weather Bureau, Stevens Institute of Technology, the Pure Air Committee of the A.S.M.E. and a number of smoke prevention bodies.

## Machine Tool Orders Show Better Distribution

Although the index of net orders for October was 27.4, as against 29.3 for September, an improved condition in the industry is reflected in a better distribution of orders and a higher percentage of domestic sales. The distribution is best shown by the following tables:

I—Companies reporting less than 10 per cent of base:

| | *A* | *B* | *C* | *Total* |
|---|---|---|---|---|
| September | 9 | 16 | 9 | 34 |
| October | 6 | 9 | 14 | 29 |

## • INDUSTRIAL REVIEW •

**The outcome of the national election had practically no effect on machinery business, favorable or unfavorable. Threats to close up shop were apparently no more reliable than political campaign oratory and their makers probably would like them forgotten. There is little hope for any appreciable increase in orders until after the turn of the year.**

**From St. Louis comes a statement that business men are quite prepared to make the best of a change in administration regardless of their personal preferences. A manufacturer of brewers' equipment is adding to payroll and lengthening hours. Machine tool and supply business in November fell below October levels. Milwaukee is looking for results in actual orders from activities of the Industrial Rehabilitation campaign but has as yet found little. Employment has increased slightly. Chicago also sees little in the way of tangible business from rehabilitation but recognizes that its own committee is just getting started. Special metal-working equipment is arousing more interest from buyers than are standard tools. Cincinnati's active rehabilitation chairman has secured a number of promising looking commitments but few of them have as yet produced many machine tool orders. There has been a little demand for second-hand machinery.**

**Machine tool men in Detroit do not expect much in the way of business until new car programs crystallize, possibly not until after the shows. Plymouth announcement has apparently stirred Chevrolet and Ford to a realization that they have a fight on their hands. Developments will be worth watching. Bank troubles in Pittsburgh have not helped matters much but the financial situation seems to be under control.**

**From Philadelphia comes word of continued dullness in machinery activity. New York is equally quiet and is watching to see what will come of the debt negotiations. It is naturally more sensitive to financial factors than are other industrial centers. Boston reports that a few deals pending before election have been held up but that feeling in general is philosophical.**

II—Companies reporting 30 per cent of base or better:

| | *A* | *B* | *C* | *Total* |
|---|---|---|---|---|
| September | 5 | 3 | 5 | 13 |
| October | 10 | 7 | 5 | 22 |

These figures show a decrease in the number of companies operating less than 10 per cent of normal and an increase in those operating better than 30 per cent of normal. A further significant factor is that for October foreign orders were about 30 per cent of the total whereas for September they were 49 per cent. The domestic business therefore showed an improvement.

The index of net orders was made up as follows: Index A (base more than $50,000), 27.9; Index B (base $10,000 to $50,000), 23.8; Index C (base less than $10,000), 24.4. This again shows a more equal division than last month. The three-months' moving average for October was 28.4 as compared with 27.7 for September.

Shipments for October again rose with an index of 45.4 divided as follows: Index A, 44.6; Index B, 49.5; Index C, 40.8. An increase in shipments was shown for each month since June, which accounts for a decrease in unfilled orders from 59.6 in September to 41.0 in October. The October index for unfilled orders breaks down as follows: Index A, 36.6; Index B, 48.6; Index C, 83.4.

## Air Cylinder Standard Adopted for Machine Tool Spindles

Developed by the technical committee on Chucks and Chuck Jaws, under the chairmanship of J. E. Lovely, chief engineer, Jones and Lamson Co., a new American standard on rotating air cylinders and adapters has been approved by the A.S.A. This work was sponsored by the A.S.M.E., N.M.T.B.A. and the S.A.E. The standard was developed to obtain interchangeability in different makes of air cylinders on spindles of machine tools without changing the adapter or draw rod.

Three sizes of adapters cover the range of standard cylinders from 3 to 18 in. inclusive. A fourth adapter is provided to accommodate a 20-in. air cylinder or other power-operated device having a draw rod pull of 26,000 to 40,000 lb.

The length of the stroke of standard cylinders, the position of the piston rod at the end of the stroke and the diameter of the tapped hole in the piston rod have also been standardized so that air cylinder draw rods do not have to be fitted to individual air cylinders.

## Business Holds Gains

Preliminary reports of the Federal Reserve Board for October indicate that the 10 per cent gain made in September has been continued. The increase in manufacturing output carried the Reserve Board's index from a low point of 58 per cent of the 1923-25 average for last July to 66 per cent for September. This rise was caused almost entirely by the larger output of the lighter industries, chiefly textiles.

In tracing the relation of heavy to light industries over a period of years, the report states that in the period 1923 to 1929 these two groups were about of equal importance. At the peak, during the summer of 1929, the durable industries produced somewhat more than half the total manufacturing output of the country.

"From the high point in 1929, the manufacturing output as a whole has fallen by about three-fourths while in other industries the decline, except for a few months in the past summer, has been less than one-fourth."

The board attributes this market difference to the fact that replacement in the construction and other durable industries can be more easily deferred.

## Finish Standards to be Set Up by Committee

A new Standarization Committee on Classification and Designation of Surface Qualities is being sponsored by the A.S.M.E. and S.A.E. and will function under A.S.A. procedure. The first meeting will be held in the Engineering Societies Bldg., New York, December 9, at 9:30 A. M. This project will include standards of quality for machined and ground surfaces, methods of inspection for quality grades standardized, and grade designations for use in specifications and drawings. Twenty-nine representatives of organizations and individuals have been appointed thus far.

## Hayden Heads Acetylene Association

At the annual meeting of the International Acetylene Association held at Philadelphia November 16, 17 and 18 the following officers were elected:

President—E. J. HAYDEN, Linde Air Products Co., Chicago.
Vice-President—HORACE B. PEARSON, Compressed Industrial Gases Inc., Chicago.
Treasurer—W. E. COTTER, 30 East 42nd St., New York.
Secretary—H. F. REINHARD, 30 East 42nd St., New York.

The meeting was opened by J. HAMPTON MOORE, mayor of Philadelphia, and addressed by SAMUEL VAUCLAIN, chairman of the board, Baldwin Locomotive Works. Among the many papers presented during the sessions were:

Recent Advances and Future Expectations of the Oxy-Acetylene Process—JAMES H. CRITCHETT, vice-president, Union Carbide and Carbon Research Laboratories, Inc.
Sales Advantages of Welded Products—J. J. FEICHTER, works manager, Heintz Manufacturing Co.
The Economic and Management Phases of the Rehabilitation Problem—JOHN M. CARMODY, editor, *Factory and Industrial Management.*
Application of Oxy-Acetylene Welding and Cutting to Plant Maintenance—Plant Representative, Bethlehem Steel Corporation.
The Training of Journeymen Welders—DR. S. LEWIS LAND, Educational Director, Heating and Piping Contractors Association.
Welded Piping in a Central Heating and Power Plant—R. D. WILLIAMS, Baker, Smith & Company.
Economies of Welded Piping in Homes—FRED MAEURER, Air Reduction Sales Co.
Presentation and Discussion of Oxy-Acetylene Committee.
Engineering as Applied to Aircraft in Flight—CAPT. ALFORD J. WILLIAMS, JR., U. S. Navy, Retired.
Welding in the Construction of Naval Aircraft—Lt. E. W. CLEXTON, Shop Superintendent, Naval Aircraft Factory, Philadelphia.
Building Up and Heat Treatment of Rail Ends—W. CONSTANCE, supervisor of reclamation, Chesapeake and Ohio Railroad.
Maintenance of Railroad Equipment by Oxy-Acetylene Welding—L. H. SCHEIFELE, Reading Co.
Maintenance of Bus and Motor Truck Equipment—JAMES W. COTTRELL, technical editor, *Commercial Car Journal.*
Welding as a Maintenance Tool in the Steel Industry—E. L. QUINN, welding superintendent, Jones & Laughlin Steel Co.
How the Steel Industry Uses Hard Facing—W. A. WISSLER, Haynes Stellite Co.
Cutting in Preparation for Welding—EVERETT CHAPMAN, Lukenweld, Inc.
Machine Cutting by the Oxy-Acetylene Process—R. F. HELMKAMP, Air Reduction Sales Co.
Some Economic Aspects of Welding Aluminum—D. E. ROBERTS, The Linde Air Products Co.
X-Ray Testing of Welds—DR. ANCEL ST. JOHN, St. John X-Ray Corporation.
Chrome Nickel Steel Riser Cutting—R. B. AITCHISON, Oxweld Acetylene Co.

"The Prosperity Process," an industrial drama in three acts, by JOHN P. WATERS, was presented in the Penn A.C. auditorium on the evening of November 16. This portrayed the dilemma of a company that received a large order and was not prepared to meet manufacturing requirements.

## Graduate Course in Engineering Distribution

A graduate course in engineering distribution, devoted to a study of the distribution of capital products, is being offered at the University of Pittsburgh with the cooperation of the Westinghouse Electric & Mfg. Co. The course is under the direction of BERNARD LESTER, assistant sales manager, Industrial Dept., Westinghouse. It will take up problems in the sale and distribution of engineering equipment and ma-

chinery required by industry, a study of industrial markets, methods employed in economic distribution, direct and through sales features of engineering products, organization and supervision of a sales force, sales methods, specifications, proposals, sales presentation and use of sales aids.

## Nobel Prize to Langmuir

The Nobel award in chemistry for 1932, the highest recognition that a scientist can receive, will be presented to DR. IRVING LANGMUIR, associate director of the General Electric Research Laboratory, in Stockholm on Dec. 10. Dr. Langmuir is the second American chemist to have been honored by the Swedish Academy of Science in 31 years. He became affiliated with the General Electric Laboratory in 1909, and his most significant development was that of the high-intensity incandescent lamp, the bulb of which contains small quantities of either nitrogen or argon. He also discovered the process of electric welding by the atomic hydrogen method. He is a past president of the American Chemical Society, is a member of various scientific societies, and has received numerous honorary degrees and medals.

## Industrial Leaders to Speak at A.S.M.E. Annual Meeting

Two noted leaders of American industry appear on the program of the annual meeting of the A.S.M.E. to be held Dec. 5-9. GENERAL JAMES G. HARBORD, chairman of the board of directors of the Radio Corp. of America, is to be the speaker at the banquet at the Hotel Astor, Wednesday evening, Dec. 7. A. W. ROBERTSON, chairman of the board of directors of the Westinghouse Electric & Mfg. Co., and recently appointed by President Hoover to be chairman of the newly established Committee on Rehabilitation of Industry, is to present the Towne Lecture on the relation of economics and engineering. This lecture will be given at 4:30 p.m. in the auditorium of the Engineering Societies Building on Thursday, Dec. 8.

## National Founders Meet in New York

The 36th annual meeting of the National Founders Association, held in New York, November 16-17, at the Waldorf-Astoria Hotel, was well attended, and almost all of the officers were continued for another year. Reports were made by S. W. UTLEY, president, COMMISSIONER MCCLINTOCK, and A. D. LYNCH of the committee on industrial education. JAMES A. EMERY spoke on "The New Deal". WHITING WILLIAMS, consultant on industrial problems, gave the result of a study of workers during the depression. The problem of silicosis, both as to its effects on workers and its danger as a source of damage suits, was discussed at length. Only one change was made in the list of officers, which is as follows: president, S. W. UTLEY, Detroit Steel Castings Co.; vice-president, THOMAS W. PANGBORN, The Pangborn Corp.; commissioner, A. E. MCCLINTOCK, Chicago, and secretary, J. M. TAYLOR, Chicago.

## •BUSINESS ITEMS•

The Warren Tool Corp., Warren, Ohio, has been formed as a result of a reorganization of the Warren Tool & Forge Co. by a bondholders' committee. It will continue the forged steel hand tool business and malleable iron foundry. New equipment is being installed. C. L. SCHOONOVER will be president and general manager; HOWARD C. MULL, vice-president in charge of sales; R. E. GIBSON, treasurer, and THORN PENDLETON, secretary. Mr. Schoonover was for 15 years the general manager of the General Fire Extinguisher plant of the Grinnell Co., at Warren.

The Oster Mfg. Co. and the Williams Tool Corp., Cleveland, have appointed the ParKett Machinery Division, Austin-Hastings Co., Inc., as one of their distributors in the New England territory of the lines of pipe and bolt threading equipment. It was incorrectly stated (*AM*—Vol. 76, p. 1132e) that the above concern was the sole distributor. Other representatives remain.

The Langbein-Pfanhauser Works, a well-known Leipsig firm manufacturing equipment for electro-deposition and cleaning of metal surfaces, has concluded an agreement with The Bullard Co., Bridgeport, Conn., under the terms of which the former is to introduce the "Bullard-Dunn" metal descaling process (*AM*—Vol. 73, p. 611, and Vol. 75, p. 814) in Great Britain and in Continental Europe.

The Ajax Electrothermic Corp. has recently licensed the Westinghouse Electric & Mfg. Co. to make high frequency or coreless induction furnaces or heaters for certain applications in the field of heating. In return, the Ajax Electrothermic Corp. has received a license from Westinghouse to use certain patents of the latter company.

The R. M. Henshaw & Co., eastern representative of Johnson Gas Appliance Co., has moved to Room 67, 221 Columbus Ave., Boston. The new location is one block from the old, a small display is maintained and warehouse facilities are at the same location.

The Improved Industries Corp., 521 Fifth Ave., New York, has been organized to finance in whole or in part the purchase and installation of equipment needed by industrial plants to carry out modernization programs. R. G. MACY, formerly connected with a New England firm of consulting engineers, is president.

The Ball & Roller Bearing Co., Danbury, Conn., has been taken over by HOWARD I. BEARD. The company was originally organized and operated by LEWIS R. HEIM.

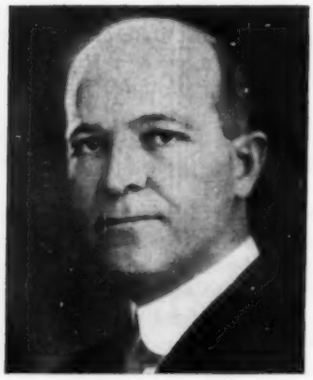
Welker-Hoops Co., Middletown, Conn., holding company for Vitascope Co., plans to terminate its corporate existence, but the latter will continue to manufacture moving picture cameras and projectors. Manufacture of automobile accessories will also be continued.

The Falk Corp., Milwaukee, has appointed G. J. STURMFELSZ as representative in the Baltimore district, with offices at 1620 East 32nd St., and H. DOUGLAS STIER in the Atlanta territory with offices at 101 Marietta St.

## Westinghouse Elects Two Vice-Presidents

F. A. MERRICK, president of the Westinghouse Electric & Mfg. Co., announced the election of two vice-presidents after the recent meeting of the board of directors held in New York. C. E. STEPHENS, formerly commercial vice-president, with headquarters in New York, was elected vice-president. He will remain in New York. N. G. SYMONDS, formerly commercial vice-president at Chicago, was elected vice-president in charge of sales. His headquarters will be at the general offices of the company in East Pittsburgh, and he will report directly to J. S. Tritle, vice-president and general manager.

Mr. Stephens joined the Westinghouse company in 1900 as an apprentice at East Pittsburgh. He supplemented his electrical experience with technical study and, after gaining wide experience in shop operations, was finally promoted to the position of illuminating engineer. He entered sales work, was made manager of the illumination section of the sales department, and was transferred to New York as a divison manager. He has remained in the New York district



C. E. STEPHENS

N. G. SYMONDS

since, and in 1930 was elected commercial vice-president.

Mr. Symonds graduated from Leland Stanford University in 1901 as an electrical engineer and joined the Westinghouse-Church-Kerr Co. at New York as a member of the stoker erecting department. The following year he was made district superintendent of stoker erection. Later he went to East Pittsburgh as assistant engineer of the Westinghouse Machine Company's stoker department, and later was sent to Chicago. In 1915 when the Westinghouse Machine Company was absorbed by the Westinghouse Electric & Mfg. Co., Mr. Symonds was appointed manager of the power division of the Chicago office. In 1921 he was appointed Chicago district manager, and in 1930 was elected commercial vice-president.

## • PERSONALS •

HUGH BENET has been appointed manager of the Harrison Works of the Worthington Pump & Machinery Corp. Since 1927, when Mr. Benet became associated with the Worthington organization, he has served as manager of the Holyoke (Mass.) Works.

E. J. BERRY, general superintendent of the Chicago Works, Link-Belt Co., spoke on November 9 before the time and motion study section, Milwaukee Society of Industrial Engineers.

H. H. FITZPATRICK, manager of the Japanese office of Alfred Herbert, Ltd., in Osaka, was in New York recently on his way from Coventry to Osaka. Mr. Fitzpatrick has been located in Japan since 1919 and is well known there.

J. C. HENDERSON has severed his connection after 17 years' service with the Driver-Harris Co., in order to develop a new product. Mr. Henderson obtained the first patents to be issued in the United States on heat-resisting castings, particularly the nickel-chromium-iron group.

IRWIN F. HOLLAND, superintendent of the small tools division, Pratt & Whitney Co., spoke at a meeting of the New Haven chapter of the A.S.S.T., on November 17, his subject being "Machining Difficulties in Alloys Steels."

H. A. LOMAX has been made manager of the newly formed roll department at the Pittsburgh Steel Foundry Corp., Glassport, Pa. The company recently undertook the manufacture of rolls of steel, alloy and iron.

GEORGE M. SHARER has been appointed sales manager of its eastern division by the Link-Belt Co. Mr. Sharer is a mechanical engineer and has been connected with Link-Belt in Philadelphia for the past 32 years.

ERNST R. STANDFUSS, vice-president of the Harnischfeger Corp., Milwaukee, returned recently from a world tour principally undertaken to observe business conditions.

## • OBITUARIES •

GERALD E. BROWNELL, superintendent of the grinding machine division, Norton Co., Worcester, Mass., died recently at the age of 58. He had been employed by Norton for 31 years, beginning as supervisor of installation of grinding machines. Later he became general foreman, and in 1918 was appointed assistant superintendent. In 1920 he rose to superintendent.

EDWARD K. HALL, a former vice-president of the American Telephone & Telegraph Co., and a director of the McGraw-Hill Publishing Co., Inc., died Nov. 10. He was 62. Recently Mr. Hall had been serving as resident lecturer in the Amos Tuck School of Business Administration at Dartmouth College. He was a lawyer and was interested in finance. He was chairman of the intercollegiate football rules committee and did much to shape the rules of the game and to bring it to its present popularity.

MALCOLM E. GRAY, founder and chairman of the Rochester Can Co., and also of the Atlantic Stamping Co., died Nov. 7. It is said that Mr. Gray was the originator of the five-day week.

WALTER L. KEITH, head of the Cleveland Block Co., Cleveland, manufacturer of steel and iron tackle blocks, died recently. Mr. Keith was the founder of the company.

CHARLES F. MEDBURY, manager of the Montreal office of Canadian Westinghouse Co., died recently. He had been in charge of the office since 1909, and was 66.

CHARLES SIDNEY PECK, 80, co-founder of the Danbury Machine Co., in 1872, and before that identified with the R. A. Belden Machine Co., died Nov. 8.

ARTEMUS W. PICKARD, vice-president of the Bass Foundry & Machine Co., Fort Wayne, Ind., died recently at the age of 62.

HUGH DAVID WALKER, managing director of Metal Craft Ltd., and president of the Grimsby Foundry Co., Ltd., and of the Steel Art Furniture Co., all located at Grimsby, Ont., died recently. He was also the organizer of the Walker Steel Range Co.

## • MEETINGS •

AMERICAN ENGINEERING COUNCIL. Annual meeting. January 15, 1933. Washington Hotel, Washington, D. C. L. W. WALLACE, secretary, 744 Jackson Place, Washington, D. C.

AMERICAN MANAGEMENT ASSOCIATION. Annual conference of the industrial marketing division. December 5-6. Hotel William Penn, Pittsburgh. KENNETH B. ANDERSEN, secretary, 20 Vesey St., New York.

SOCIETY OF AUTOMOTIVE ENGINEERS. Annual meeting. January 23-26. Book-Cadillac Hotel, Detroit. JOHN A. C. WARNER, secretary, 29 West 39th St., New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual meeting. December 5-9. New York. CALVIN W. RICE, secretary, 29 West 39th St., New York.

MALLEABLE IRON RESEARCH INSTITUTE. Annual meeting. December 14. Cleveland. ROBERT E. BELT, secretary, 1820 Union Trust Bldg., Cleveland.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. December 5-10. Grand Central Palace, New York.

# THE ROUND TABLE

## Taking Chances

"Say, Al, there's something I've been wanting to ask you for a long time, but I forget it every time I see you. It really isn't any of my business, but still—I'd like to know."

"Sure, Ed, when you're ready."

"Well, have you and Mason any patents on the compressor?"

"Sure, several good ones. The revolving cylinder is basic, and there are several detail patents on the blade, corner packing and so forth."

"Are they in the firm name, or Mason's?"

"In Mason's, I guess. I never bothered much about it.

"Never bothered about it! For the love of Pete, Al, what did you put your good money into the business for? What did you think you were buying for it?"

"I thought I was buying just what I got—association with Mason in the manufacture of a rotary compressor, patents, drawings and good will included."

"Yes, but do you know you got all that? Were your share of the patents, drawings and good will transferred to you?"

"No, not in writing, but it was all agreed to between Mason and myself."

"Yeah. But suppose you don't continue to agree; what good is a verbal agreement then? You call yourself a business man and do a thing like that."

"Mason and I have been friends for years. I trust him. I get along with him, and I expect our business connections to be permanent. If, for any reason, we dissolve partnership, I expect we will dissolve the assets equitably. I can't imagine a condition where we would want to manufacture rotary compressors in competition with one another. So what good would half interest in the patents do me, anyway?"

"Yes, but you can use business methods and have something to show for your money. You and Mason disagree frequently to judge by what you tell me, and some time one of you will carry the disagreement so far that it can't be patched up. Then you'll be out in the cold."

"I don't think so, Ed. Neither Mason nor I are quarrelsome, nor do we hold a grudge. We disagree, sure; but we are both fair and logical. Argument usually clarifies the situation or, if not, we are both willing that the other should try out his ideas, be they right or wrong."

"Yeah, but the mere fact that you do have disagreements is dangerous. It isn't the seriousness of the disagreement that matters. It's irritation over little things that cause war, murder and divorce, not oppression. The time will come when you or Mason will not be feeling quite up to par mentally and will resent what the other does or says. One of you will place himself in a position where he thinks he can't back down. It will be hard for you to do that, because not having protected yourself, you are at his mercy. He can step out with half the cash and machinery and all the orders even if he is honest. On the other hand, if you are entitled to half the manufacturing orders, he would think twice about it. So, for both your sakes, transfer the patents to the firm."

***Is Al careless in not having the patents assigned to the partnership?***

## *Discussion*

### Borrowing from the Bank

Caleb Sprague of the First National is, no doubt, a progressive, wide-awake individual, active in social and civic affairs in his community. Through his business and social contacts, he has kept himself well-informed as to Al and Mason's activities and probably has anticipated being approached regarding a loan.

Mr. Sprague has been approached repeatedly by men attempting to secure loans; that is a part of his business. He knows the chronic borrower and the novice, and it is doubtful if he can be bluffed.

Al and Mason are ambitious. They are not waiting for an opportunity to expand, but are working to create such an opportunity. Eventually, they will be faced with the problem of securing a loan. To approach Mr. Sprague abruptly regarding a loan, and if unsuccessful, to issue an ultimatum relative to his depositor's account would be a big mistake on Al's part. He would undoubtedly gain the enmity of Mr. Sprague as well as an unsavory reputation at the Trust Company and elsewhere.

Al would do well to stop in and pay Mr. Sprague a social call. A friendship should be cultivated and business problems discussed. Mr. Sprague's opinion will be good. His methods of approaching Al's problems from the financial angle will be helpful.

Mr. Sprague would welcome such overtures and social calls, and I feel sure that if the time ever came that Al and Mason needed cash they could depend on assistance from the First National.

—Ira S. Williams.

There is one infallible rule. Don't wait until you have to.

When you go, remember that the bank has to loan its money to someone or go out of business. If you keep a balance of, say, a thousand dollars most of the time and you want two thousand more to use for a short time, figure out for yourself what the bank makes if you continue to leave a thousand dollars

on deposit and pay interest on the two thousand. It is probably about 9 per cent. That is banking, and that is what you have to do to make your account desirable.

If the bank is going to make 9 per cent on its money, and they think you will be able to pay your interest and the principal, you can call the president out of bed in the middle of the night to get your loan. —E. H. Fish.

## Slightly Worn

Under this heading appeared an article (*AM*—Vol. 76, page 1100) which we believe should not have been placed there, because of the following objections:

| | Second Hand | New Machine |
|---|---|---|
| Cost | $2000.00 | $8000.00 |

It is not customary and in only rare cases that a second-hand machine can be bought for as low as 25 per cent of the price of a new machine.

| | Second Hand | New Machine |
|---|---|---|
| Estimated Life | 1½ years | 6 years |

Why should a second-hand machine last only 1½ years, against 6 years for a new machine, since a new machine is nothing more or less than a second-hand machine as soon as it starts to operate. There are many second-hand machines bought and sold over again after having been used by the second owner for quite some time and are in better condition than some machines that are bought new and only used thirty days. Our contention is that a used machine, if bought from a reputable dealer, who sells it with a guarantee for condition, is just as good and will last as long as a new machine.

| | Second Hand | New Machine |
|---|---|---|
| Fixed Charges per year including interest | $1787.00 | $1813.00 |

How does your correspondent figure a difference of only $26 when the interest on the difference in cost of $6000 amounts to many times this sum?

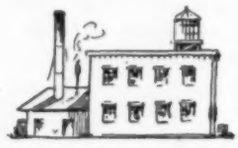
—Louis Hyman,
*Joseph Hyman & Sons.*

The problem as to whether a piece of equipment should be bought is always confronting the small manufacturer with limited capital. If the issue is thoughtfully analyzed, it generally resolves itself into a cold-blooded business proposition. In the case in question, it is strikingly evident that if something is not done, the possibility of obtaining repeat orders and interesting new prospects is decidedly in favor of a competitor. Due consideration must be given the following items:

1. Can costs be reduced by buying a new, modern, up-to-date machine, and if so, would this reduction result in obtaining more orders with a corresponding increase of production?

2. Are conditions such that for a projected period only partial production could be obtained? If this be the case, then there is a gambler's chance that a second-hand machine might be the best investment.

3. Assuming that the second-hand machine could be financed from available capital while it would be necessary to borrow money to buy the new one, what is the best course to follow? The question is again based on the conditions of the industry; if everything points to increased demand for the product over an extended period, then it would be quite in order to borrow the money and buy the most modern tool available with the thought always in mind that it must pay for itself within a specified time.



4. Before any of the foregoing considerations are entertained, the item of design should be given extensive thought. If, after careful study it seems advisable, the design should be changed so that the work could be done by an available machine. If this can be done, then the expenditure for either a new or second-hand tool should not be made at all.

—Harold L. Wynn,
*Executive Engineer, Pacific Electric Manufacturing Corporation.*

For anyone starting in the business of putting a new machine on the market, it would be advisable to avoid buying expensive machinery until there is some assurance that a fair demand for the product is established. While it may cost a little more to have the machine work done in an outside shop there is, nevertheless, the big advantage that a good job will be done or there will be no expense.

As soon as the business is built up to where it is steady enough to take advantage of the economy of equipping for full production then the question of new or second-hand machinery may be considered. My experience has been that on work which has rather a liberal tolerance second-hand machinery can often be used to advantage, but on accurate close-tolerance production, it is important not only to have high-grade new machinery but to select careful high-class workmen to operate it.

It has always been a mystery to me why some concerns will purchase first class machinery at a substantial price and then put the first man who claims to be a machine operator on the job of running it; then after doing this to pay no more attention to the matter as long as the production card shows he is keeping up with schedule. I have seen some of the finest machinery practically ruined in a short time because the operator was only interested in the day's production record, and as long as the machine would revolve and the stuff pass the limit-gage inspection, he had no further interest.

If anyone is going to use this class of men then it would probably be better to buy nothing but used machines because they will be wrecked in short order and the loss then is not so great. But anyone, who uses as much judgment and care in picking workmen, as he does in checking up customers' credit, should buy only brand new and high grade machines for first class production. —George P. Pearce.

## Books and Bosses

It appears that the newly formed business not only lacks a cost system but also a set of books. The necessity of keeping the ordinary records and accounts is recognized in any business, and the reasons for maintaining such a system are so numerous and common that it is sufficient to state that they should be kept.

A cost system, on the other hand, should justify its existence by pointing out to the management savings, inefficiencies and aid in the determination of proper selling prices to the extent of more than paying for the cost of installation and operation. Should there be any question whatever about the economy of its adoption, it would be far better to invest the money to determine whether or not it is required, than to linger along wondering about it, taking unknown losses.

Concerning a desire to be agreeable, it may safely be said that such agreement is to be fostered so long as the problems in question are of little consequence. But where a discussion arises which concerns the welfare of a business in which an equal interest is shared by those of the different opinions, the right thing, and not agreement should be sought. Any one who is not willing to bring such a discussion to a definite conclusion in a friendly and business-like manner should not take any active part in the operation of a business in which he has a share. —R. E. Long,
*Steacy Schmidt Manufacturing Co.*

American Machinist
Reference Book Sheet

# Inch—Millimeter Conversion Tables*

## Table 1—Inches to Millimeters

(Basis: 1 inch = 25.4 millimeters)

| In. | Mm. | In. | Mm. | In. | Mm. | In. | Mm. |
|---|---|---|---|---|---|---|---|
| 1 | 25.4 | 26 | 660.4 | 51 | 1295.4 | 76 | 1930.4 |
| 2 | 50.8 | 27 | 685.8 | 52 | 1320.8 | 77 | 1955.8 |
| 3 | 76.2 | 28 | 711.2 | 53 | 1346.2 | 78 | 1981.2 |
| 4 | 101.6 | 29 | 736.6 | 54 | 1371.6 | 79 | 2006.6 |
| 5 | 127.0 | 30 | 762.0 | 55 | 1397.0 | 80 | 2032.0 |
| 6 | 152.4 | 31 | 787.4 | 56 | 1422.4 | 81 | 2057.4 |
| 7 | 177.8 | 32 | 812.8 | 57 | 1447.8 | 82 | 2082.8 |
| 8 | 203.2 | 33 | 838.2 | 58 | 1473.2 | 83 | 2108.2 |
| 9 | 228.6 | 34 | 863.6 | 59 | 1498.6 | 84 | 2133.6 |
| 10 | 254.0 | 35 | 889.0 | 60 | 1524.0 | 85 | 2159.0 |
| 11 | 279.4 | 36 | 914.4 | 61 | 1549.4 | 86 | 2184.4 |
| 12 | 304.8 | 37 | 939.8 | 62 | 1574.8 | 87 | 2209.8 |
| 13 | 330.2 | 38 | 965.2 | 63 | 1600.2 | 88 | 2235.2 |
| 14 | 355.6 | 39 | 990.6 | 64 | 1625.6 | 89 | 2260.6 |
| 15 | 381.0 | 40 | 1016.0 | 65 | 1651.0 | 90 | 2286.0 |
| 16 | 406.4 | 41 | 1041.4 | 66 | 1676.4 | 91 | 2311.4 |
| 17 | 431.8 | 42 | 1066.8 | 67 | 1701.8 | 92 | 2336.8 |
| 18 | 457.2 | 43 | 1092.2 | 68 | 1727.2 | 93 | 2362.2 |
| 19 | 482.6 | 44 | 1117.6 | 69 | 1752.6 | 94 | 2387.6 |
| 20 | 508.0 | 45 | 1143.0 | 70 | 1778.0 | 95 | 2413.0 |
| 21 | 533.4 | 46 | 1168.4 | 71 | 1803.4 | 96 | 2438.4 |
| 22 | 558.8 | 47 | 1193.8 | 72 | 1828.8 | 97 | 2463.8 |
| 23 | 584.2 | 48 | 1219.2 | 73 | 1854.2 | 98 | 2489.2 |
| 24 | 609.6 | 49 | 1244.6 | 74 | 1879.6 | 99 | 2514.6 |
| 25 | 635.0 | 50 | 1270.0 | 75 | 1905.0 | 100 | 2540.0 |

Note: The above table is exact.

## Table 2—Millimeters to Inches

(Basis: 1 inch = 25.4 millimeters)

| Mm. | In. | Mm. | In. | Mm. | In. | Mm. | In. |
|---|---|---|---|---|---|---|---|
| 1 | 0.039370 | 26 | 1.023622 | 51 | 2.007874 | 76 | 2.992126 |
| 2 | 0.078740 | 27 | 1.062992 | 52 | 2.047244 | 77 | 3.031496 |
| 3 | 0.118110 | 28 | 1.102362 | 53 | 2.086614 | 78 | 3.070866 |
| 4 | 0.157480 | 29 | 1.141732 | 54 | 2.125984 | 79 | 3.110236 |
| 5 | 0.196850 | 30 | 1.181102 | 55 | 2.165354 | 80 | 3.149606 |
| 6 | 0.236220 | 31 | 1.220472 | 56 | 2.204724 | 81 | 3.188976 |
| 7 | 0.275591 | 32 | 1.259843 | 57 | 2.244094 | 82 | 3.228346 |
| 8 | 0.314961 | 33 | 1.299213 | 58 | 2.283465 | 83 | 3.267717 |
| 9 | 0.354331 | 34 | 1.338583 | 59 | 2.322835 | 84 | 3.307087 |
| 10 | 0.393701 | 35 | 1.377953 | 60 | 2.362205 | 85 | 3.346457 |
| 11 | 0.433071 | 36 | 1.417323 | 61 | 2.401575 | 86 | 3.385827 |
| 12 | 0.472441 | 37 | 1.456693 | 62 | 2.440945 | 87 | 3.425197 |
| 13 | 0.511811 | 38 | 1.496063 | 63 | 2.480315 | 88 | 3.464567 |
| 14 | 0.551181 | 39 | 1.535433 | 64 | 2.519685 | 89 | 3.503937 |
| 15 | 0.590551 | 40 | 1.574803 | 65 | 2.559055 | 90 | 3.543307 |
| 16 | 0.629921 | 41 | 1.614173 | 66 | 2.598425 | 91 | 3.582677 |
| 17 | 0.669291 | 42 | 1.653543 | 67 | 2.637795 | 92 | 3.622047 |
| 18 | 0.708661 | 43 | 1.692913 | 68 | 2.677165 | 93 | 3.661417 |
| 19 | 0.748031 | 44 | 1.732283 | 69 | 2.716535 | 94 | 3.700787 |
| 20 | 0.787402 | 45 | 1.771654 | 70 | 2.755906 | 95 | 3.740157 |
| 21 | 0.826772 | 46 | 1.811024 | 71 | 2.795276 | 96 | 3.779528 |
| 22 | 0.866142 | 47 | 1.850394 | 72 | 2.834646 | 97 | 3.818898 |
| 23 | 0.905512 | 48 | 1.889764 | 73 | 2.874016 | 98 | 3.858268 |
| 24 | 0.944882 | 49 | 1.929134 | 74 | 2.913386 | 99 | 3.897638 |
| 25 | 0.984252 | 50 | 1.968504 | 75 | 2.952756 | 100 | 3.937008 |

Note: The above table is approximate:
1/25.4 = 0.039370078740 +

## Table 3—Common Fractions of an Inch to Millimeters

(Basis: 1 inch = 25.4 millimeters)

| 2nds | 4ths | 8ths | 16ths | 32nds | 64ths | Decimal Inch | Millimeters | 2nds | 4ths | 8ths | 16ths | 32nds | 64ths | Decimal Inch | Millimeters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .. | .. | .. | .. | .. | 1 | 0.015625 | 0.396875 | .. | .. | .. | .. | .. | 33 | 0.515625 | 13.096875 |
| .. | .. | .. | .. | 1 | .. | 0.031250 | 0.793750 | .. | .. | .. | .. | 17 | .. | 0.531250 | 13.493750 |
| .. | .. | .. | .. | .. | 3 | 0.046875 | 1.190625 | .. | .. | .. | .. | .. | 35 | 0.546875 | 13.890625 |
| .. | .. | .. | 1 | .. | .. | 0.062500 | 1.587500 | .. | .. | .. | 9 | .. | .. | 0.562500 | 14.287500 |
| .. | .. | .. | .. | .. | 5 | 0.078125 | 1.984375 | .. | .. | .. | .. | .. | 37 | 0.578125 | 14.684375 |
| .. | .. | .. | .. | 3 | .. | 0.093750 | 2.381250 | .. | .. | .. | .. | 19 | .. | 0.593750 | 15.081250 |
| .. | .. | .. | .. | .. | 7 | 0.109375 | 2.778125 | .. | .. | .. | .. | .. | 39 | 0.609375 | 15.478125 |
| .. | .. | 1 | .. | .. | .. | 0.125000 | 3.175000 | .. | .. | 5 | .. | .. | .. | 0.625000 | 15.875000 |
| .. | .. | .. | .. | .. | 9 | 0.140625 | 3.571875 | .. | .. | .. | .. | .. | 41 | 0.640625 | 16.271875 |
| .. | .. | .. | .. | 5 | .. | 0.156250 | 3.968750 | .. | .. | .. | .. | 21 | .. | 0.656250 | 16.668750 |
| .. | .. | .. | .. | .. | 11 | 0.171875 | 4.365625 | .. | .. | .. | .. | .. | 43 | 0.671875 | 17.065625 |
| .. | .. | .. | 3 | .. | .. | 0.187500 | 4.762500 | .. | .. | .. | 11 | .. | .. | 0.687500 | 17.462500 |
| .. | .. | .. | .. | .. | 13 | 0.203125 | 5.159375 | .. | .. | .. | .. | .. | 45 | 0.703125 | 17.859375 |
| .. | .. | .. | .. | 7 | .. | 0.218750 | 5.556250 | .. | .. | .. | .. | 23 | .. | 0.718750 | 18.256250 |
| .. | .. | .. | .. | .. | 15 | 0.234375 | 5.953125 | .. | .. | .. | .. | .. | 47 | 0.734375 | 18.653125 |
| .. | 1 | .. | .. | .. | .. | 0.250000 | 6.350000 | .. | 3 | .. | .. | .. | .. | 0.750000 | 19.050000 |
| .. | .. | .. | .. | .. | 17 | 0.265625 | 6.746875 | .. | .. | .. | .. | .. | 49 | 0.765625 | 19.446875 |
| .. | .. | .. | .. | 9 | .. | 0.281250 | 7.143750 | .. | .. | .. | .. | 25 | .. | 0.781250 | 19.843750 |
| .. | .. | .. | .. | .. | 19 | 0.296875 | 7.540625 | .. | .. | .. | .. | .. | 51 | 0.796875 | 20.240625 |
| .. | .. | .. | 5 | .. | .. | 0.312500 | 7.937500 | .. | .. | .. | 13 | .. | .. | 0.812500 | 20.637500 |
| .. | .. | .. | .. | .. | 21 | 0.328125 | 8.334375 | .. | .. | .. | .. | .. | 53 | 0.828125 | 21.034375 |
| .. | .. | .. | .. | 11 | .. | 0.343750 | 8.731250 | .. | .. | .. | .. | 27 | .. | 0.843750 | 21.431250 |
| .. | .. | .. | .. | .. | 23 | 0.359375 | 9.128125 | .. | .. | .. | .. | .. | 55 | 0.859375 | 21.828125 |
| .. | .. | 3 | .. | .. | .. | 0.375000 | 9.525000 | .. | .. | 7 | .. | .. | .. | 0.875000 | 22.225000 |
| .. | .. | .. | .. | .. | 25 | 0.390625 | 9.921875 | .. | .. | .. | .. | .. | 57 | 0.890625 | 22.621875 |
| .. | .. | .. | .. | 13 | .. | 0.406250 | 10.318750 | .. | .. | .. | .. | 29 | .. | 0.906250 | 23.018750 |
| .. | .. | .. | .. | .. | 27 | 0.421875 | 10.715625 | .. | .. | .. | .. | .. | 59 | 0.921875 | 23.415625 |
| .. | .. | .. | 7 | .. | .. | 0.437500 | 11.112500 | .. | .. | .. | 15 | .. | .. | 0.937500 | 23.812500 |
| .. | .. | .. | .. | .. | 29 | 0.453125 | 11.509375 | .. | .. | .. | .. | .. | 61 | 0.953125 | 24.209375 |
| .. | .. | .. | .. | 15 | .. | 0.468750 | 11.906250 | .. | .. | .. | .. | 31 | .. | 0.968750 | 24.606250 |
| .. | .. | .. | .. | .. | 31 | 0.484375 | 12.303125 | .. | .. | .. | .. | .. | 63 | 0.984375 | 25.003125 |
| 1 | .. | .. | .. | .. | .. | 0.500000 | 12.700000 | 2 | 4 | 8 | 16 | 32 | 64 | 1.000000 | 25.400000 |

Note: The above table is exact; all figures beyond the six places given are zeros.

*The basis of 1 in. = 25.4 mm. is proposed by the American Standards Association and leading manufacturers instead of the present ratio of 1 in. = 25.40005 in. The difference is but two millionths of an inch.

© American Machinist

# • IDEAS FROM PRACTICAL MEN

## Press Tools for Bending Flat Springs

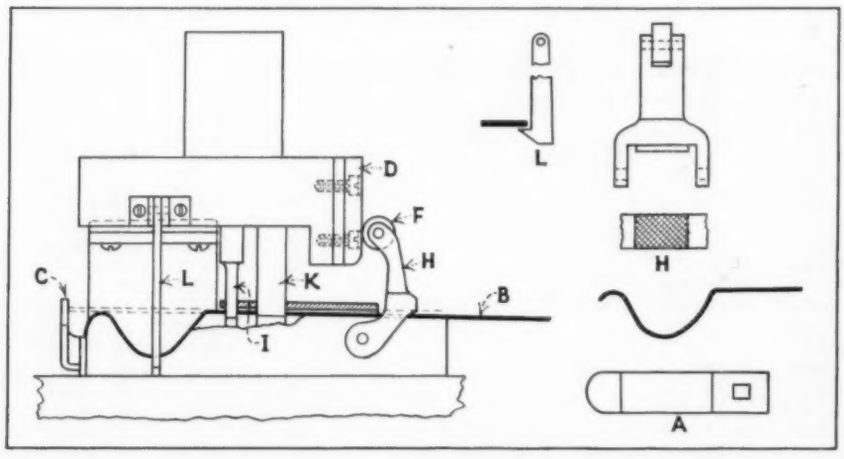
FRANK A. GABRIEL

In making press tools for bending flat springs, such as the one shown at *A* in the illustration, several features were embodied that, with variations, can be applied to tools for other work along the same lines.

The springs were made from strip steel 0.020x0.625 in. and one spring was completed at each stroke of the press. The strip *B* is fed to the stop *C*, and on the down stroke of the ram and before bending takes place, the hardened piece *D* on the side of the punch-holder contacts with the roller *F* on the pivoted gripper *H*, forcing the gripper to pinch the strip against the face of the die. During the bending operation, the strip is held securely by the action of the gripper, so that all of the draw in bending is in one direction, thus insuring uniformity in the length of the springs.

The bending punch is backed by a piece of rubber, so that when the bend has been completed the resiliency of the rubber permits further descent of the ram, bringing into action the piercing punch *I* and the cut-off punch *K*. The hardened piece on the side of the punch-holder is also backed by rubber for resiliency in the action of the gripper and to compensate for variation in the thickness of the stock. On the up stroke of the ram, the spring is lifted from the die by the latch-stripper *L* and is dropped to the bolster. From here it slides into a box below, the bed of the press being inclined.

The stripper plate, guide posts, etc., have been omitted from the assembly drawing of the tools, so as to show the features of design more clearly. Details of the gripper and the latch-stripper are given in the upper right-hand corner of the illustration, being denoted by the same reference letters by which they are indicated in the assembly view.

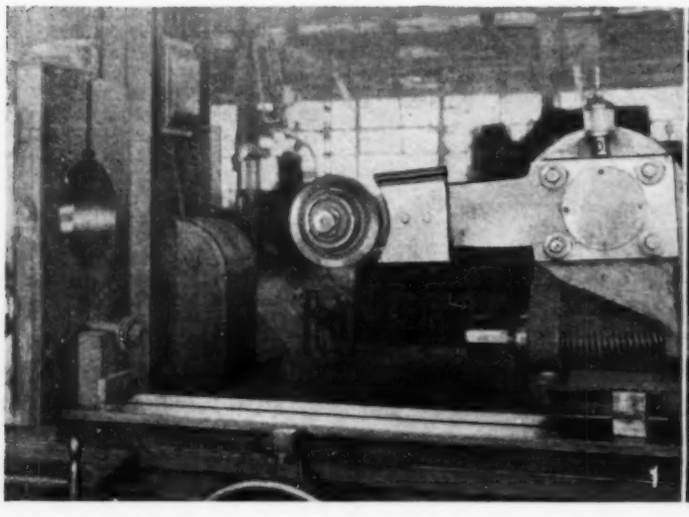


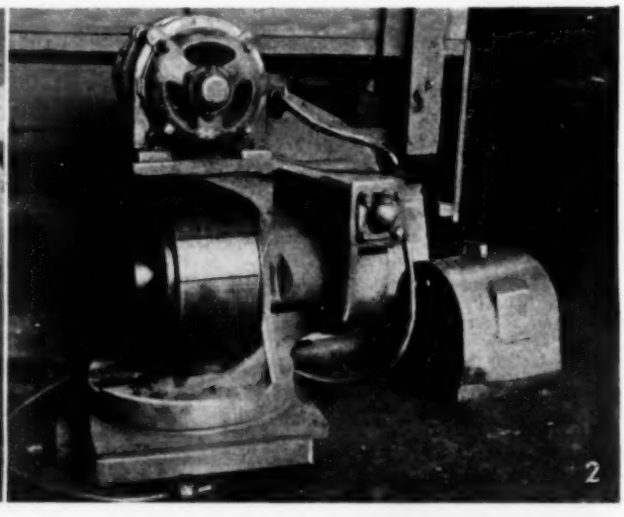

## Grinding Fixtures for Special Work

CHARLES F. HENRY

Grinding keyways is not common practice in many kinds of work. But on some of the larger parts of oil-well machinery the National Supply Company at Torrance, Calif., finds it advantageous to do so. A special head rigged up on a Landis grinder, shown in Fig. 1, can grind keyways on shafts or in the bore of holes large enough to admit the wheel. The wheel is driven by a silent chain inclosed in the arm. The weight of the wheel arm is carried by a pair of coil springs above the cross-slide.

Another grinding attachment, for large spherical bearing shells, is shown in Fig. 2. Here a motor is mounted on top and drives the expanding mandrel beneath it by a chain through the worm of the reducing gear at the back. This unit is mounted on a suitable grinding machine. The shell is put on the expanding mandrel and revolved in front of the grinding wheel while it is at the same time swiveled on the base of the fixture. The combined movement gives the desired shape to the outside of the shell. The motor is covered, when not in use, by the hood at right.

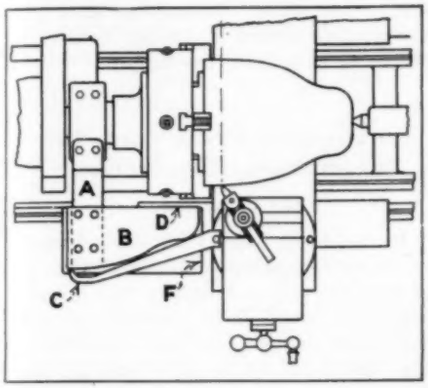

1


2

## Lathe Attachment for Turning Irregular Shapes

WALTER WELLS

Devices and machine attachments are usually designed so that the work can be done by the less-skilled operators. The attachment described, while it brings a variety of work within reach at small expense, requires a skilled operator to get the best out of it. Saving much of the time usually spent in turning the outlines on irregular work, the device merely requires the scribed outline of the shape to be turned. On form turning, the more intricate the shapes, the more reason for using the device. On internal work it makes the tool travel visible. On long, steep tapers it permits the cut to be




taken clear across the work, instead of taking it in short steps with the short travel of the compound rest.

The attachment consists of the bracket *A;* the plate *B;* and the pointer *C*. The sides *D* and *F* of the plate, being used as base lines, must be accurately square with each other. The bracket is attached to the headstock by the screws of the front bearing cap and has a double bend so that the plate can be positioned in proper relation to the height of the pointer, which is secured by one of the locking nuts of the compound rest. The tip of the pointer must be of the same shape as that of the turning tool. After the specified outline has been scribed on the coppered surface of the plate, using the base lines *D* and *F*, the plate is mounted on the bracket and is trued up to the travel of the carriage by an indicator. The tool and the compound rest are adjusted to bring the pointer and the tool in their correct relative positions to the starting point.

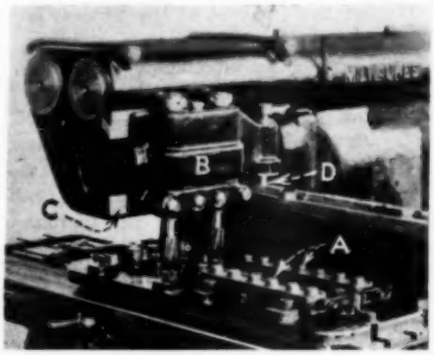
Advanage should be taken of the automatic longitudinal feed in so far as is possible. The trick of using this device is to attune the hand cross-feed delicately to the eye as the eye concentrates on the travel of the pointer along the line, the longitudinal feed meanwhile taking care of the traverse. As in all turning operations, the work must be finally finished by filing or grinding. In cases where indents are rather steep, it is usually good practice to use the power cross-feed and to traverse the carriage by hand. The scribed outline on the plate can be removed by grinding to allow for other outlines, thus making the device universal and long lived.

## Milling Around Obstructions

DUDLEY L. CURTIS

Sometimes it is necessary to mill surfaces where the path of the cutter must be varied, due to some obstructions, such as the bosses on the valve guides at *A* in Fig. 1. In this particular case the fixture is arranged to hold four pieces in tandem pairs. The vertical flanges at the edges of the work must be milled at the ends as well as at the sides.

The two-spindle sliding head *B* is mounted on the slide *C*, which is attached to the machine column and is supported by the overarms. The drive is through a splined shaft held in the main spindle, thus permitting the sliding head to move freely either toward or away from the column. At the inner end of the sliding head is the cam roller *D* engaging in a cam at F. Guided by the cam, the sliding head and the cutters follow the path of an elongated figure eight, the cutters going along the fronts and one-half of the ends of the flanges in the pair of pieces in one direction and crossing over to the rear flanges in the tandem pieces. On the return movement of the table, the opposite sides and the portions of the end flanges not already machined are milled.



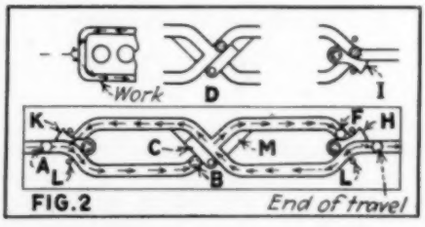




FIG. 2

Details of the cam are given in Fig. 2, the arrows indicating the path of the cutters. Assuming that milling starts with the cam roller in the position A, the cutters would follow the lower part of the cam race to the position *B*. At this point the pivoted deflector *C* contacts with the cam roller. As the cam continues its travel, the deflector, contacting with the cam roller, takes the position indicated at *D*, above, until it has passed the roller, thus deflecting the roller to the upper part of the cam race; then the deflector is returned to its normal position by a spring. As the cam further continues its travel and the roller is at *F*, the pivoted deflector *H* contacts with the roller and is pushed aside, as at *I*, above, until the cam reaches the end of its travel; then the deflector is returned to its normal position by a spring.

At this point, the direction of the table is automatically reversed and the cam roller is forced into the lower part of the cam race by the deflector *H*. When deflector *C* contacts with the cam roller, the roller is guided from the lower to the upper part of the cam race. Eventually, deflector *K* contacts with the roller, permitting it to pass into the straight part of the cam race, thus ending the cycle. Pins *L*, two at each end of the cam, limit the movements of deflectors *H* and *K* in both directions, but the movement of deflector *C* is limited by angular shoulders at *M*.

In the upper left-hand corner of Fig. 2 is shown one end of the work to be milled, as well as the path of one of the cutters. With this set-up, the duties of the operator are limited to loading and unloading the fixture, since all the movements are automatic. This method can be used when the path of the cutters is even more irregular than that shown. The only limitation will be the capacity of the machine available.

## Rolling Tubes to Various Shapes

FRANCIS W. SHAW

*Tool and Gear Consultant*
*Heywood, England*

Tubes can be rolled into many external and internal shapes by the Sharp process, the arrangement of the tools being shown in Fig. 1. The rolling is done by steel balls and is performed in one operation, thereby avoiding annealing. A machine of the lathe type is employed for the work and the tube is placed on a mandrel, one end being held and driven by a chuck. If desired, the tube can be attached to the mandrel by a pin passing through holes in both members, the pin also serving as a driver.

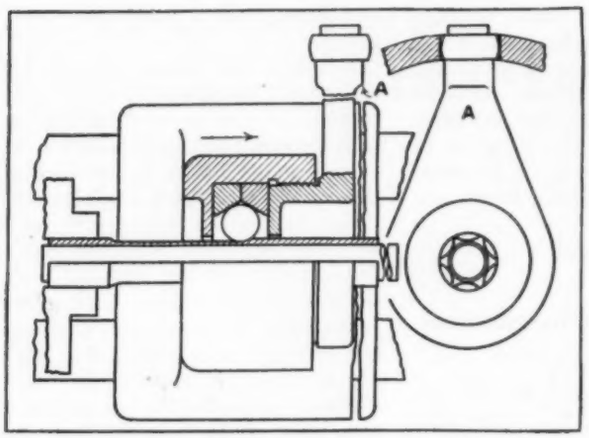
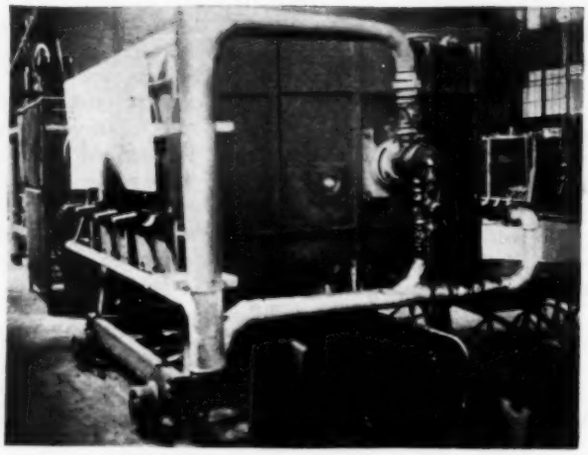



Fig. 1—Rolling tubes on a mandrel by balls in an adjustable ball race



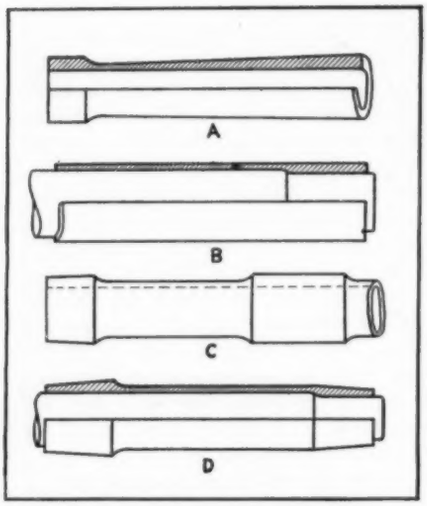



Fig. 2—Some of the shapes that can be produced

The carriage carries a ball bearing in a container, the race of the bearing being of unusual construction. It is in the form of a V-groove and is split through the point of the V. One half can be moved laterally in the container, opening or closing the V and permitting the balls to roll in a circle of larger or smaller diameter.

Movement of this half of the race is controlled by the lever *A*, which has a threaded hub engaging an internal thread in the container. Turning the lever in one direction permits the pressure on the balls to force the movable half of the race away from its mating half. Turning the lever in the opposite direction forces the movable half toward its mate. Motion of the lever is automatically controlled by a former, the roller at the end of the lever engaging in a slot of the desired shape. Thus the tube can be rolled to any shape determined by the contour of the slot in the former.

Changes in interior shape are governed both by the shape of the former and the shape of the mandrel. A few of the shapes that can be rolled are shown in Fig. 2. Externally- and internally-butted tubes, as at *A* and *B*, have been produced for use in the manufacture of bicycles. By allowing the balls to move outward radially, parts of the tube, as at *C*, can be left unrolled, or can be rolled to a diameter different from that of the original. A taper and a butt, as at *D*, can be formed at the same rolling.

One of the features of the process is that tubes upon which copper or other metals have been electrically deposited can be rolled satisfactorily, the deposited metal thinning down as well as the basic tube. A disadvantage of the process is that, owing to the balls traveling in a helix, the finished surface is slightly corrugated, and smoothing the corrugations appreciably weakens the tube. There is no tendency for the tube to cling to the mandrel, which can be extracted easily by a slight pull.

## A Portable Oil Furnace

W. J. TANGERMAN
*Shop Superintendent, Union Metal Products Co.*

Portable oil-burning forges and rivet heaters are quite common, but we have found it necessary recently to design a portable furnace for heating bar stock. The furnace is normally used for heating stock for the bulldozer, but is at times used for heating stock for a board drop-hammer. The necessity for inserting other equipment between the machines at times makes it impossible to move them closer together. As an alternative, we built up a channel frame running on cast wheels which in turn run on a track inset in the concrete floor of the forge shop. The fuel oil line can be connected at either end of the furnace, and the air blast pipe can be connected to either of two openings in the airblast line. This permits change of position in a few minutes, and also allows the operator to drain any cold oil from the furnace supply line before starting up, since he has a valve always at the opposite end of the furnace from the supply.

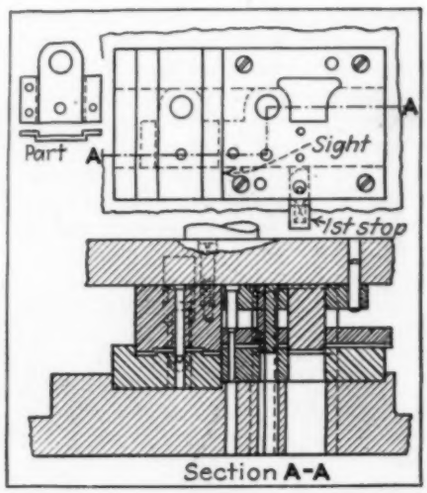
## Inexpensive Press Tools for Economical Production

JOHN J. MCHENRY

In spite of today's silent factories, there is much activity among producers of novelties and new devices that are required in small lots. Quotations are wanted on lots of from 10,000 to 40,000, the tool costs to be absorbed in the price quoted. The bidder, to get in line, must strip his tool cost to the minimum. His toolroom and his press room must also cooperate 100 per cent.

It is for this type of job that the tools herewith illustrated were constructed. The part made is shown in the upper left-hand corner of the drawing. As for the tools, I believe that a less expensive construction is almost impossible.

In operation, the stock is advanced to the first stop and on the down stroke of the ram, one-half of the rounded end is notched. The stock is then advanced

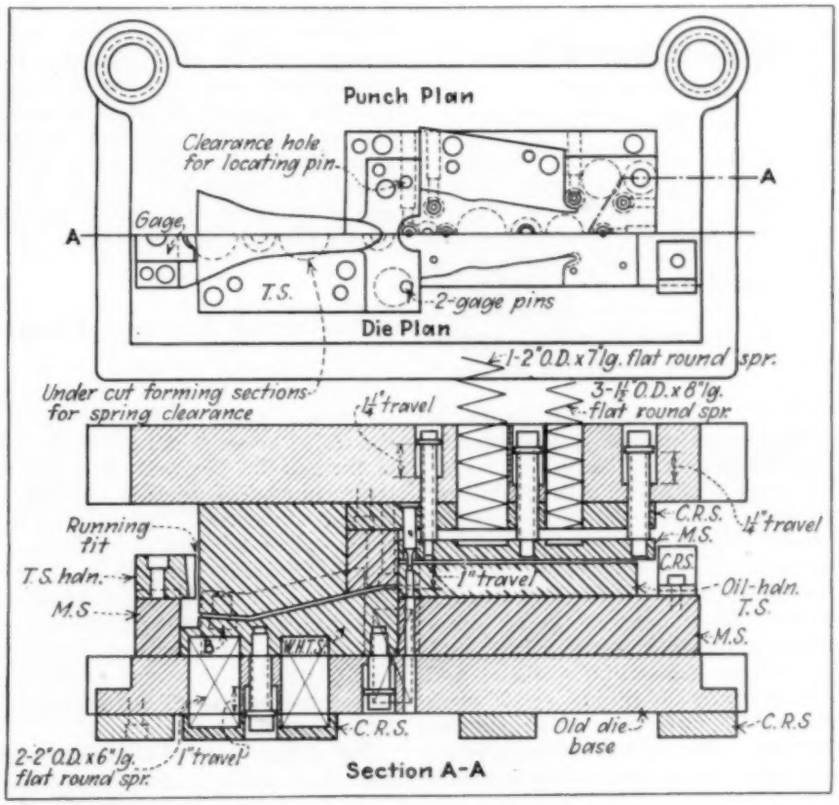


until the edge is even with the cut off die. Care must be taken to have this just as near right as is practical by sighting or aligning the edges of the stock and the die by the eye. There is no mechanical stop. At the next stroke, the five holes are pierced and the other half of the rounded end is notched, thus completing the shape of the part before cutting off and forming. The third stop is against the forming block, and when the ram has reached the bottom of the stroke, the part has been accurately located by the two central pilots, cut off and formed. On the up stroke of the ram, a spring pin strips the work from the pilots and the punch, and the part falls through the back of the inclined press. The operator uses a short stick to speed up the removal of the formed part, the production being 2,000 or more per hour.

By using coil stock we got about 3,000 pieces per coil. Taking this into consideration as against the necessary time to arrange a positive second stop, and also the limited quantity of pieces required, it was found to be more economical to use the sight method described.

## Rebuilt Progressive Die

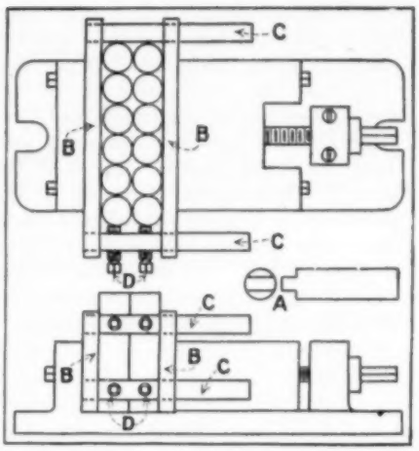
Progressive dies are fairly common for multiple operation work on small pieces fed in the strip. The illustration shows the same idea applied to a roof bracket. This tool is built up on an old die by adding steel parts to the cast-iron. The work is fed in the strip by hand, and at each stroke of the press a completed piece drops out. Piercing and notching is the first step; cut off, emboss and form stamp part-number, the second. Feed is against a stop at the left, beveled slightly to prevent the work from being pulled at the shear edge during the initial stages of the forming operation. This gage block also acts as a heel for punch member during its descent. Hardened tool steel buttons back the quick-removable punches, and headless S.A.E. setscrews hold them in place. To get added space for spring pockets underneath the stripper plate for the forming operation, cold rolled steel flats are screwed to the base. The hardened steel numbering punch is set in the hardened forming punch and mates against a copper matrix *B* in the lower member.




## Equalizing Pressure of Vise Jaws—*Discussion*

CHARLES KUGLER

In reading the article by Francis Paquin under the title given above (*AM*—Vol. 76, page 948), I was reminded of a method I used for clamping twelve pieces of cold-rolled steel for milling tongues on one end, as shown at *A* in the illustration.



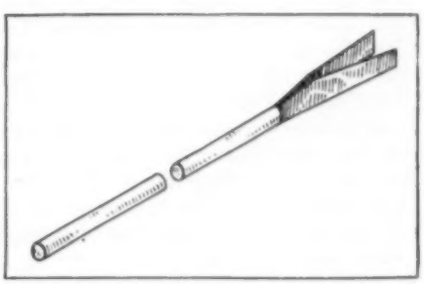

Since the quantity to be milled would not warrant the expense of an elaborate fixture, the one illustrated was made as a compromise. Two pieces of cold-rolled steel *B* were drilled for the four rods *C*. Near one end of two of the rods, two holes were drilled and tapped for the ½-in. setscrews *D*. With the pieces *B* held in the machine vise, the work was placed between them and the vise was closed. Then the setscrews were tightened on the work, holding it securely in spite of any variation in diameter.

We had but three cutters of the same diameter, otherwise the rods *C* could have been made longer and as many pieces could have been milled at one time as the vise would hold. The advantages of this method of holding the work over that described by Mr. Paquin are: First, the difference in cost of the fixtures; second, increased production, since in my fixture the pieces are close together and the cutters are cutting almost continuously; and third, the method of holding the work is more reliable because it is not dependent upon the heat generated to melt the wax.

## Tool for Inserting Screws

HERBERT P. HINCKLEY
*President, Herbert Hinckley, Incorporated*

Having on several occasions to start screws in awkward places, I made the tool illustrated. It consists of a piece of ⅜-in. round rod 11 in. long and two



pieces of phonograph spring 2 in. long. One end of the rod is slotted and the pieces of spring are soldered in the slot.

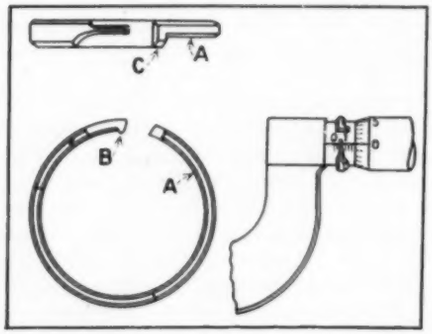
In use, the two spring pieces are sprung together by the thumb and forefinger and are entered in the screw slot. They are then released and hold the screw by their opening pressure. If the screw slot is in good condition, a fairly large screw can be held and started in the tapped hole. No handle is needed, since enough grip can be obtained on the rod to spin the screw in quickly.

## A Safety Attachment for Micrometers

GEORGE J. MURDOCK
*Murdock Research Laboratory*

Errors in reading micrometers are costly and are most likely to result in getting the work too small. The most prolific cause of errors comes from accidentally turning the thimble, so that in taking the next cut, more is taken off than is intended.

As a remedy for these conditions and to enable the workman to proceed with confidence, the split-ring sliding stop illustrated was devised. It consists of a ring cut off from drill rod that has been




bored for a tight fit on the micrometer barrel. It is then split and filed to the form shown in the illustration. From near one end and extending about one-third of the way around, the ring is narrowed, as at *A*. At the other end it is narrowed for a short distance and has an internally-projecting V-point, as at *B*. To attach the ring to the micrometer, the thimble and the screw are removed and the ring is snapped over the end of the barrel, the V-point engaging the line that is parallel with the barrel and preventing the ring from turning. The screw and the thimble are then replaced and the screw is run down until the end of the thimble contacts with the ring and squares it on the barrel. It is then pushed down with the fingers as far as it will go, in which position it is kept when not in service.

When it is desired to bring the ring into service, the micrometer is set to the required finish dimension of the work and the ring is pulled up against the end of the thimble. The micrometer is then opened to the rough dimension of the work, and the amount of metal to be taken off is estimated by glancing at the space between the end of the thimble and the part *C* of the ring without taking the trouble to read the graduations. This method is used in successive cuts until the work is nearly to size, when the depth of cut is, of course, regulated by the reading of the graduations.

The narrow part *A* of the ring is to permit the reading of the 0.0001-in. graduations on the barrel. The narrow part of the end having the V-point is to permit the junction of the graduations on the thimble with the lines on the barrel to be clearly seen.

The spring tension of the ring on the barrel is such that the ring can be moved up and down with the fingers, yet when the bottom of the thimble comes into contact with it, a distinct stop is felt. Since it takes considerable pressure to move the ring, the thimble cannot be accidentally turned below the graduation at which the ring is set. Therefore, there is little likelihood of getting the job too small through any fault of measurement, while considerable time is saved. At the right in the illustration, part of a micrometer is shown with the ring in place.

## Milling a Curved Taper

A. W. HACKER
*Foreman, Machine Shop*
*Union Metal Products Co.*

Some time ago, we were required to mill a taper on a casting which, for want of a better name, may be described as a "curved" taper, that is having a curved or twisting surface such as shown on the front edge in Fig. 1. We decided to use a milling machine with a universal head, with the spindle in a vertical position and a mill that cut on the side as in Fig. 2.

With two C clamps we held a pair of guide bars on one side of the universal head housing. Each bar carried a guiding finger of sufficient strength to hold the head rigidly while cutting. The block was then placed on its side beneath the universal head, with the slotted edge up. It was set at an angle to give the desired curve as the cutter swung out on the center of the head. By proper manipulation of the feed cranks, the guide fingers would follow the parallel surfaces below the slots on the edge. The angle of the work swung the cutter out as work moved and made

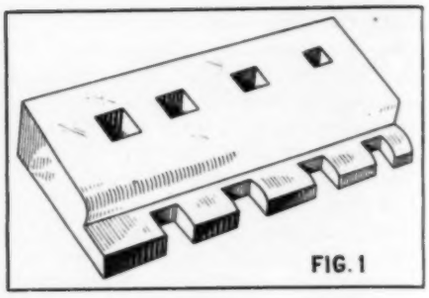



**Fig. 1—The block, showing the taper after machining**

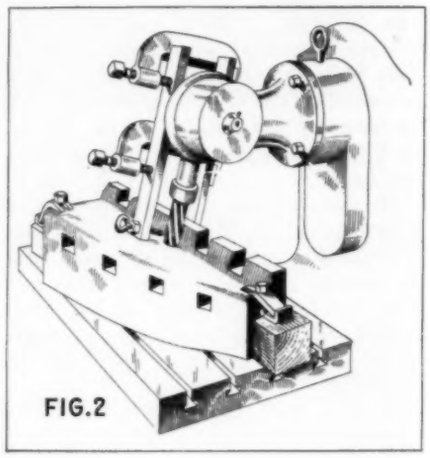



**Fig. 2—The set-up on the miller**

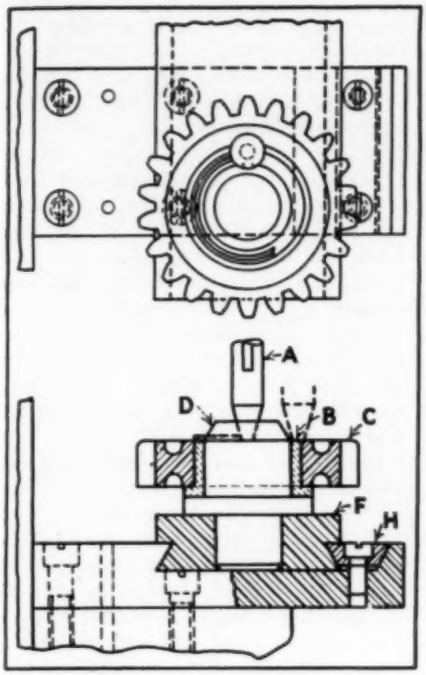
it cut the curve as shown in Fig. 1. In fact, the block was so positioned that only two feed cranks were required, one to lift the table in order to keep the cutting edge always in the same relation to the piece as the head gradually swung forward, and the cross feed. The two guiding fingers held the cutter in contact with the block at all times, while the angular position of the block on the table gradually forced the universal head forward, thus changing the angle of the side of the cutter and forming the constantly changing slope desired.

## A Universal Riveting Fixture

D. L. BROWN

A high-speed hammer was used with the special punch *A* for riveting one end of the bronze bushing *B* in the hub of the gear *C*. Several similar jobs on the same machine made it advisable to design a universal fixture in which various sizes of plugs *D* could be inserted. The plugs are made a slip fit in the hole in the sliding base *F*, which can be locked in any position by the angular gib *H*. The stationary base of the fixture is attached by screws to the knee of the machine, which can be adjusted for height on the column.

The sliding base and the interchangeable plugs make it possible to rivet a

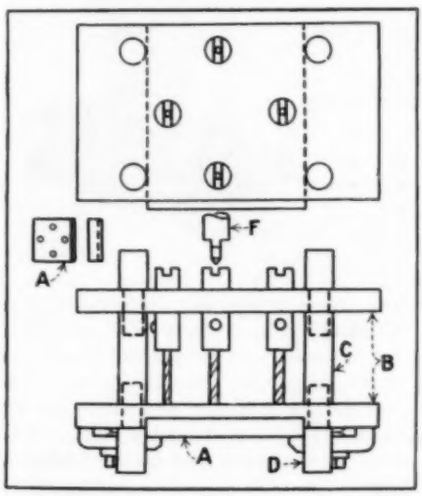



large variety of work in the one fixture. It is necessary only to insert a plug of the correct diameter and height and to adjust the sliding base so that the riveting punch will line up with the work. The gear is rotated by hand while the hammer is in action until the entire end of the bushing has been riveted.

## Drill Jig Fitted With Drills
### *Discussion*

W. H. MOORE
*Hamilton, Ontario, Canada*

A machine shop of moderate size received an order for drilling 1,000 brass plates, such as the one shown at *A*. The plates were flanged at one edge and the four holes to be drilled in them were of different sizes. Since there was no multi-spindle drill in the shop, it was necessary to find some way of drilling the holes at one setting without changing the drills. The result was a jig fitted with drills, as illustrated.




The jig consists of the two plates *B;* four pieces of pipe *C* for spacers; eight shoulder pins *D,* driven tightly through holes in the plates and into the pipes; four drills held in sockets and secured by screws, the upper ends of the sockets being slotted for the flatted driver *F;* and two clamps for holding the work up against the bottom of the lower plate. The flatted driver has a pilot to engage holes in the sockets. The upper plate is drilled to fit the sockets, and holes in the lower plate serve as guides for the drills. The work is loaded with the jig upside down, being located by the shoulder pins in the lower plate.

In operation, the jig is moved so that each socket in turn is brought in alignment with the driver. When the spindle of the machine is brought down, the flats on the driver engage the tongue in the socket and revolve both it and the drill.

# SEEN AND HEARD

JOHN R. GODFREY

### Temperature and Accuracy

Our quest for accuracy has forced us to consider expansion much more carefully than ever before. The effect of holding a snap or ring gage in the hand for only a few seconds, is very noticeable on a close fitting plug. Drafts of cool air across a bench or machine may easily raise Cain with accurate fits. Appreciation of this is shown in one of the Westinghouse plants where a large gear hobber is enclosed in an insulated housing to prevent temperature changes that would affect the accuracy of the work. In such a case it is not so much the actual temperature as the avoidance of changes that counts. But it is well to bear in mind always that the standard temperature for all precision measurements is 68 deg. F.

### Changes in Cutting Tools

Perhaps there has been no greater change in the past 50 years in any one item of shop practice than in cutting tools. Back in the 80's tools were made of "steel"—and that was all there was to it. To be sure we each had our favorite brands, just as at present, but plain, high-carbon tool steel was the last word. Then Mushet came to us from England and Taylor and White gave us their red-hot cutting steels. Tungsten became common as an alloy and we now have high speed steels galore, all of them good. Now the Army has decided that molybdenum is a good substitute for tungsten and we use more kinds of alloys than we ever dreamed of before. And I haven't even mentioned Stellite or the T-C alloys. Cutting tools have come to be a study by themselves.

### Plastic Wood in the Shop

Did you ever mislay your bunch of keys and have to pry the hinges or lock off your tool chest or cabinet? Next time don't waste time—and words—plugging the tornout screw holes with pegs of wood and glue. Get a small can of plastic wood and fill the torn-out holes with it, tamping it firmly in place. In a few minutes, smooth off the excess material, replace lock or hinges and drive home the screws. Allow to remain at rest for a few hours and the chest or cabinet will be as good as before it was burglarized.

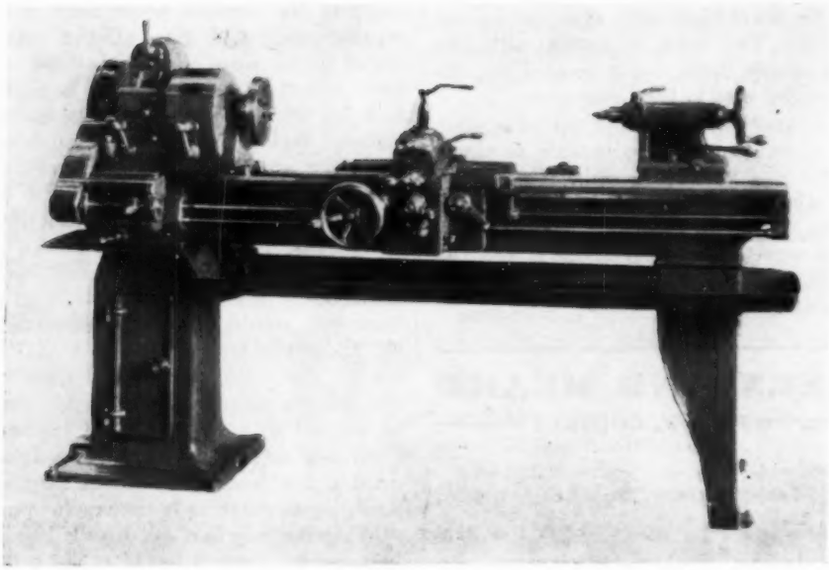
When wooden patterns have been damaged by using a big lag screw as a draw iron, repairs may be quickly made by filling the jagged hole with plastic wood. For making small and more or less delicate patterns, plastic wood may be molded with the fingers to approximate size and shape, and after having dried a few hours, the shapes may be finished into patterns in the regular way.

When the hole in a wooden file handle becomes too large to hold a file properly, simply tamp the hole full of plastic wood, drive in the tang of a file and in a very short time the handle may be used again, and rest assured, it will hold the file securely. Should plastic wood become too thick, it may be thinned with alcohol, but it is better to use a solution made by the makers.

### How Hot Bearings?

Friction in bearings always shows itself in heat unless the heat is dissipated in some way. Where the heat is excessive for any reason it is not uncommon to blow air on the bearing or to force water around it. Undue heat is, however, usually a sign that something has gone wrong in the bearing. It is a signal to the operator to look for trouble. As some bearings run hotter than others he should know how warm a bearing should be before it indicates danger. Some claim that 212 deg. is O.K. on an electric motor bearing, while others set the temperature limit at 180 deg. In some special machines the bearings are designed to run too hot to hold the hand on them, to take up as much of the clearance as possible and so insure more correct alignment. How hot should a bearing run?

# SHOP EQUIPMENT NEWS



## LeBlond Super Regal Engine Lathe

A simplified engine lathe at a popular price has been introduced by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. This "Super Regal" lathe embodies features for safe, simple control and automatic lubrication.

In addition to the eight selective speed changes, the feed reverse and feed compounding gears are inside the headstock to eliminate tumbler gears and swinging plates on the end of the lathe. All gears are of steel, heat-treated and normalized.

Controls are centralized. Controls for the feed box, speed changes, feed reverse, feed compound and the motor are within reach of the left hand of the operator without his moving from the working position. The apron is a double-walled one-piece casting in which all moving parts run in oil. Rack pinion and handwheel are mounted on ball bearings. A plunger pump in the apron reservoir lubricates the carriage and cross-slide ways and the cross-feed screw bearings. One safety interlocked trip lever controls both carriage cross-slide movements and is tripped easily.

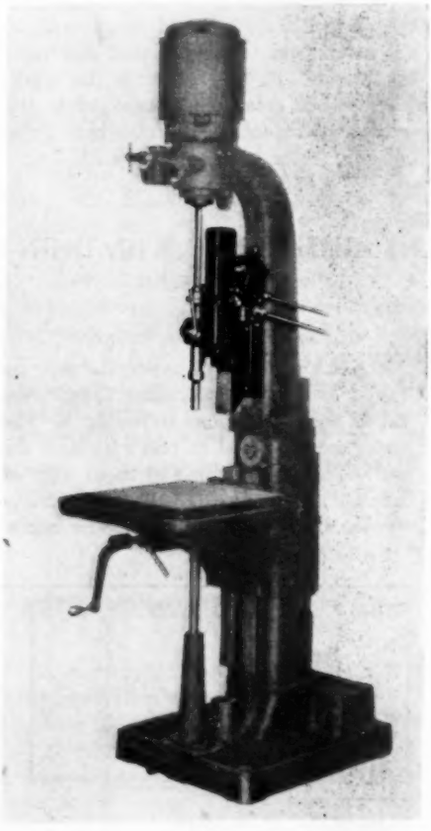
The motor is mounted on a hinged plate at the rear of the leg. Its position requires no extra floor space and is high enough to be free of floor dust. Drive is by V-belt to eliminate headstock vibration. The lathe is built in 12 and 14-in. sizes with any bed length required.

## Hydraulic Feed for Leland-Gifford Sensitive Drilling Machines

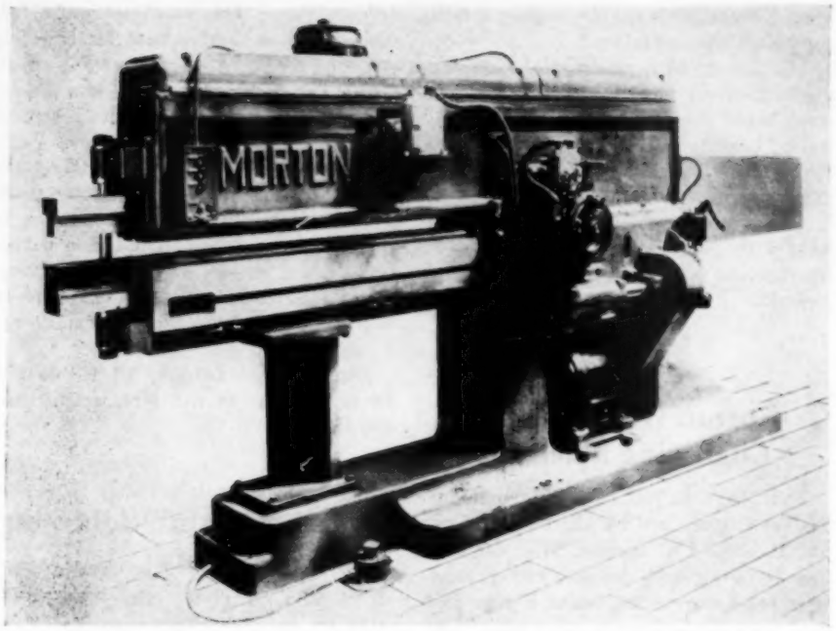
Sensitive drilling machines built by the Leland-Gifford Co., Worcester, Mass., may now be equipped with the same hydraulic feed that has been furnished for a number of years on the "Unit-Cycle" machine. This feed is applicable to either the belt or motor-spindle machine, and is designed so that it can be applied to new machines or to machines in service.

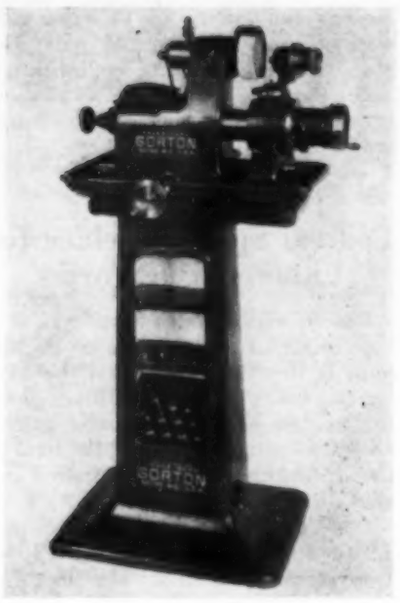
Either a continuous or a step-by-step control can be supplied for the hydraulic feed. When the operation is such that the drill does not have to be relieved in the hole, because of the need for coolant or to furnish clearance for chips, the continuous feed cycle is furnished. For drilling long deep holes in drop-forgings and other tough materials, the step-by-step method of control is provided. The latter method insures removal of chips from the hole at regular intervals, and at the same time allows the lubricant to enter the hole. Long drill life between grinds, less drill breakage, straight holes and high production are advantages of this method in such operations as drilling long oil-holes in crankshafts, connecting rods, and king bolts. Ordinary twist drills may be employed at a large saving in cost over gun-barrel drills.

Usually the maximum feed is 6½ in., although when long holes are to be drilled a feed of 10 in. can be furnished. Length of the steps with the step-by-step control can be varied from 3/16 in. up. Feed is adjustable from 0 to 40 in. per min. Rapid approach and return are provided for, and the entire feed mechanism stops automatically at the end of each cycle. A hand starting



arrangement can be provided for individual hydraulic feed units, or a number of units can be started simultaneously from one control valve. The spindle and quill are adjustable quickly in the slide to position the drill in relation to the work and to suit drills of various lengths.



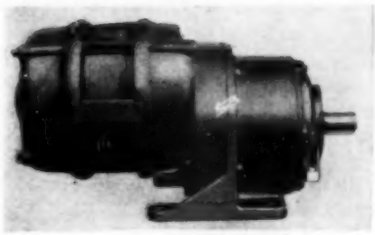
## Morton High-Duty Draw-Cut Flash Trimming Machine

Designed for trimming strips, sheets or plates, particularly in the form of automobile fenders and special shapes, a high-duty draw-cut flash trimming machine has been announced by the Morton Mfg. Co., Muskegon Heights, Mich. It has a 48-in. cutting stroke, but can be furnished with any length of cutting stroke desired.

In general the machine is similar in construction to others previously described, but in this case it is entirely electrically controlled, and compressed air is not required for clamping the work while trimming. Trimming is done on the inward stroke of the ram only. Any slight variation in the thickness of the metal, which would have a tapering effect in cutting, is taken care of automatically as the upper jaws press firmly on the outside of the work, making automatic adjustment for thickness. The work is set against a stop block making it unnecessary to use heavy pressure in binding. Distance between the center of the rams and the floor is approximately 42 in. Distance between the clamping jaws and the cutters when the upper ram is raised is approximately 2 in. to assure easy loading. Operating floor space required is approximately 5x14 ft. Shipping weight is 8,000 lb.

## "Ideal" Geared Motors

Geared motors having a gear reduction unit built integrally with the motor can now be supplied by the Ideal Electric & Mfg. Co., Mansfield, Ohio. The high speed gear is mounted directly on the motor shaft. Units are available in all gear ratios from 2.09 to 1 up to 376 to 1, giving output speeds from 861 r.p.m. to 4.7 r.p.m. using the standard 1800-r.p.m. motor. For reduction ratios up to 6 to 1, the reducer consists of a single-stage helical gear unit. For ratios up to and including 24.5 to 1, a two-stage reducer is employed. For ratios of 30 to 1 and higher, one stage of helical and one stage of heliocentric gears gives the required reduction. Geared motors are supplied in all horsepowers from ¾ to 20. Open or inclosed motors are furnished.



## Gorton No. 375-1 Universal Cutter Grinder

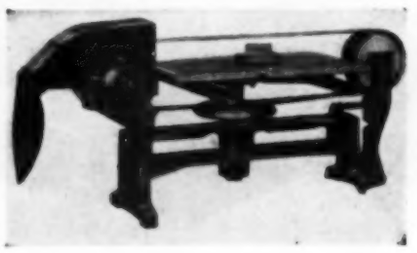
For grinding small milling and die-sinking cutters, the George Gorton Ma-Co., Racine, Wis., has developed the No. 375-1 universal cutter grinder. The universal tool head accommodates many types of cutters with all kinds of angles and reliefs. It has been used for grinding and lapping small cutters and mills tipped with tungsten and tantalum carbide.

The machine grinds to any angle, fluted mills, and single lip, two lip and three- or four-sided cutters. It handles straight shank cutters from 1/10 to ⅝ in. in diameter, and is designed for grinding small delicate points down to 0.015 in. and smaller. Almost any length straight shank cutter can be accommodated.

The machine is equipped with a precision ball bearing spindle mounting a 4-in. cup wheel. Drive is from a ¼-hp. motor at the rear through a V-belt. A round-nose cutter-grinding attachment can be supplied extra. The grinder can be furnished either as a bench machine or with a pedestal.

## Oliver No. 298 Belt Sander

Designed particularly for use in metal-working shops, the No. 298 belt sander developed by the Oliver Machinery Co., Grand Rapids, Mich., is suitable for certain types of metal grinding and polishing such as bronze tablets, aluminum and brass castings, as well as all kinds of woodwork. Flat work up to 46 in. long and 26 in. wide can be supported directly on the table and sanded or polished at one setting. The table will lower to allow a height of 9 in. from the top of the table to the bottom of



the top belt. Belts up to 5 in. wide may be used. Besides flat work, the machine will take care of swelled panels either convex or concave. The machine is driven by a 1-hp. motor. Floor space is 7 ft. 2 in. by 3 ft. 8 in.

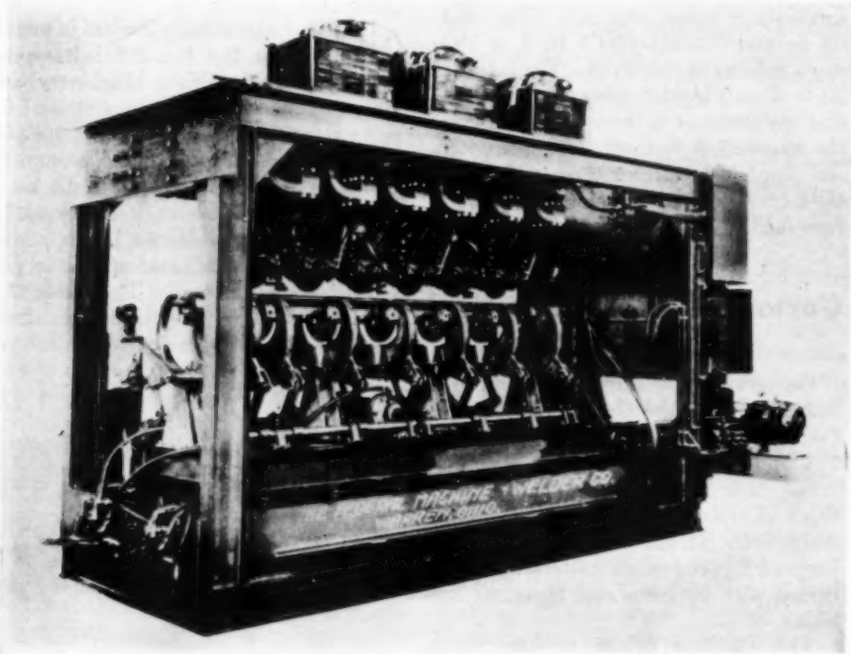
## Federal Special Welder for Concrete Pile Forms

Concrete piles cannot be driven, so a tapered steel form of 14, 16 or 18 gage must be developed to fit over the driving mandrel. The whole is driven down to bed rock and the mandrel collapsed enough to withdraw, leaving the form in place. The concrete is then poured and allowed to harden.

One form is required for each pile. Economical and rapid production of these forms is essential. Therefore The Federal Machine & Welder Co., Warren, Ohio, developed a special machine utilizing the electrical resistance method. Sheet metal is trimmed and formed into overlapping taper half tubes, which are positioned in the machine and welded longitudinally at the rate of 30 tubes per hour by two men. It is stated that the cost has been reduced 60 per cent.

The special machine illustrated has a fabricated frame that carries three 100-kw. transformers. Each transformer is attached to two separate heads which move vertically by means of pneumatic cylinders. They are adjustable for 14 to 18 in. spacing longitudinally. Each head carries a segment type of contact roll, and the welds are made in series. Resistance of the overlapping metal to the passage of current generates the heat. Pressure from the segment rolls completes the operation.

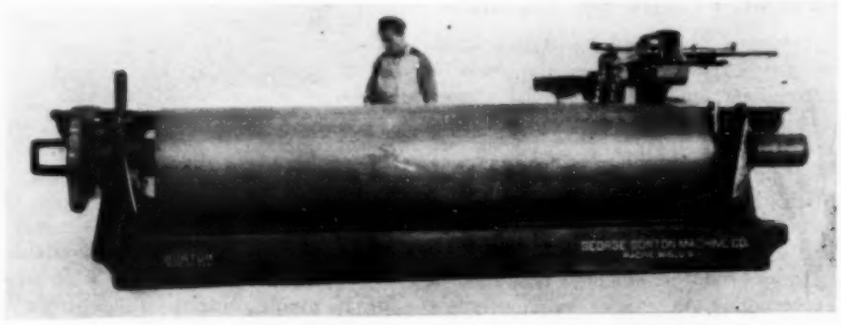
The arbor and pneumatic clamping mechanism are mounted on a structural steel table, traveling longitudinally on roller bearing sheaves, and operated hydraulically so that the speed of travel can be adjusted. Maximum movement is 18 in. and enables the six heads to weld 9 ft. in 30 seconds. Operation of the machine is semi-automatic and interlocked.



## Gorton No. 3-R Roll Engraving Machine

The No. 3-R roll engraving machine has been developed by the George Gorton Machine Co., Racine, Wis., for cutting lettering and designs, either sunk or in relief, on rubber, brass, copper and steel printing and embossing rolls. The machine will handle all sizes from the smallest diameter and shortest face up to a maximum of 30 in. in diameter by 12½-ft. face. This machine is also furnished with a shorter base for handling rolls up to 30 in. in diameter by 8-ft. face. The machine operates in a similar manner to Gorton pantograph machines for die-cutting, engraving and high-speed profiling. The operator traces the lines of a brass templet or pattern made several times larger than the design to be cut on the roll. An indexing fixture is supplied with a dial, which clamps directly on the journal of the roll to be engraved. A clamp lever locks the roll in any desired position.

Dimensions: Length, 16 ft.; height, 58 in.; width, 48 in. Net weight, 10,500 lb.



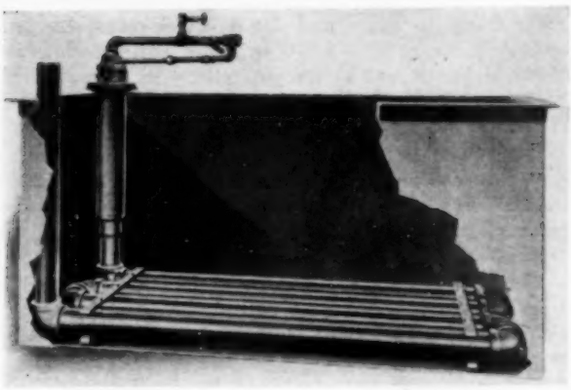
## "Flosol Cream" Soldering Flux

"Flosol Cream" soldering flux, developed by the American Chemical Paint Co., Ambler, Pa., is a white creamy chemical, shipped in 12-lb. cans and 60-lb. pails. It is brushed on the metal to be soldered, and the coating dries in from 10 to 15 min. The flux-covered surface can be tinned and soldered either before or after the coating dries.

This flux was developed for soldering sheet steel, where the prevention of rust is of importance. The film of flux does not run or spread when heated. Residue after soldering can be removed with a wet cloth. A single application is usually sufficient. The white color is of advantage in preventing the missing of areas that should be soldered.

## SteCom Immersion Heater

Gas-fired immersion heaters for heating soda solutions in metal cleaning apparatus and for heating galvanizing tanks have been developed by the Steam & Combustion Co., Inc., 1559 Sheffield Ave., Chicago, Ill. The heater is essentially a gas burner firing into a submerged refractory lined combustion



chamber extended into a pipe coil, also submerged. Both elements supply the necessary surface for transfer of heat. Heaters are of two standard types, the two-valve type and the proportional mixer or one-valve type. Products of combustion should be within 150 deg. F. in excess of the bath temperature Heaters are built in two sizes, Nos. 3 and 4, with capacities of 85,000 and 175,000 B.t.u. per hour with air at 2.5 oz. Heat outputs are higher with increased air pressures.

## Allis Splash-Proof Motors

Water splashed under pressure and from any angle is claimed not to gain entrance into the splash-proof motor announced by The Louis Allis Co., Milwaukee, Wis. This motor is said to be adequately ventilated, and is built to the same dimensions as standard open motors. A double baffle in an elliptical-shaped air passage in each end bell provides protection. The construction permits free passage of ventilating air but traps and drains water splashed into the air openings. A shaft guard prevents water from entering the bearing chamber.

## Manhattan Extensible Tip for Endless Rubber Fabric Belts

The Manhattan Rubber Mfg. Division, Raybestos-Manhattan Inc., Passaic, N. J., has developed an extensible tip for endless fabric belts. The operation is made to the outside plies of the belt before the two ends are interlapped and made endless. It consists of a series of perforated holes in the outside plies into which tie-gum is pressed. The rest of the union is interlapped, cemented and vulcanized in the usual fashion. The perforations, filled with pliable tie-gum, allow more than usual extension of the splice when it bends around small pulleys. The tip is designed to eliminate splice separation of endless fabric belts.

## Gray 36-In. Throat Metal Cutter

Another size of metal cutter has been introduced by The Gray Machine Co., Box 596, Philadelphia, Pa. This size has a 36-in. throat and $\frac{3}{8}$ in. capacity. It also has the patented revolving turret head that permits cuts to be made in all directions in a sheet too large to be turned through the throat.

The eccentric is detachable from the main drive shaft, and the crosshead is constructed so that eccentrics of various throws and positive action may be inserted. Throw ranges from $\frac{5}{8}$ to $\frac{1}{32}$ in. This feature allows the use of the shearing attachment for making intricate shear cuts in light stock, and converts the nibbling machine into a high-speed shear. It also permits the use of small eccentrics for making shapes in light stock. Cutting speeds can be changed from 550 r.p.m. in maximum stock to 1,200 r.p.m. in light stock. The cut can be made to a scribed line at both high and low speeds.

## Starrett No. 700 Inside Micrometer Caliper

An inside micrometer caliper designed to measure directly and accurately the dimensions of holes, slots or grooves which are too small for regular inside micrometers has been developed by the L. S. Starrett Co., Athol, Mass. All dimensions between 0.200 and 1 in. can be measured directly in thousandths. The micrometer combines the sliding jaws of a slide caliper and the easy-reading thimble and sleeve arrangement of a micrometer caliper. One jaw is fixed and the other is attached to the sleeve. Both jaws are cut away to facilitate measuring in close quarters. Position of the jaws can be fixed and the caliper converted into a fixed gage by a twist of the locknut. A feature is the small knurled extension on the thimble which spins between thumb and finger and speeds up opening or closing of the jaws.

## "Wearprooft" Hardening Process

A process for localized surface hardening has been developed by the Mackintosh-Hemphill Co., Pittsburgh, Pa. This "Wearprooft" process can be applied to gears, pinions, coupling boxes, spindles and similar products subjected to extreme wear. They can be taken from stock or service and given this treatment. The process was developed primarily for treating the company's special alloy cast-steel "MacHempIte."

The Wearprooft process, it is stated, introduces no stress during the processing, and none thereafter. No distortion is introduced to require subsequent

dressing. Penetration is under accurate control, and hardness ranges from 60 to 90 Sclerescope, and is regulated according to service conditions. Either cast or machined surfaces may be treated.

## Milburn Types M and N Paint Spray Guns

Two paint spray guns have been placed on the market by the Alexander Milburn Co., 1416-1428 W. Baltimore St., Baltimore, Md. Type M (illustrated) is for large industrial and automotive work, and the Type N for fine

touch-up and high lighting. The body of the gun is made of aluminum alloy. Passages for air or fluid are all straight to eliminate clogging. The handle is forged. The Type M weighs 1¼ lb.; the Type N, ½ lb. Body of the gun forms a triangular frame to house and protect the working parts.

The atomizer head has a seat in its base into which the hardened steel nozzle seats. The head is formed in one piece and drilled so that the holes go straight through to permit easy cleaning. Fluid is controlled by a removable needle valve made of stainless steel. A special latch releases the paint control and also allows the full air supply to be used for dusting. Both guns can be furnished for siphon or pressure feed and with various nozzles.

## Gorton No. 3-K "Matrix" Profiling and Die-Cutting Machine

Designed for production of precision work in steel stamps, letters and designs, sunk or in relief, and on either flat or curved surfaces, the No. 3-K "Matrix" profiling and die-cutting machine has been introduced by the George Gorton Machine Co., Racine, Wis. The 3-K is suitable for production profiling of small parts which are held to close limits, and for small intricate duplicate dies, punches, cams, templets and gages.

Undercutting is minimized through an improved pantograph and cutter head arrangement. In addition to the large ball bearings on which the cutterhead and link are mounted, ball bearing slides grip the head directly above the cutter. The pantograph is connected to these ball-bearing mounted slides.

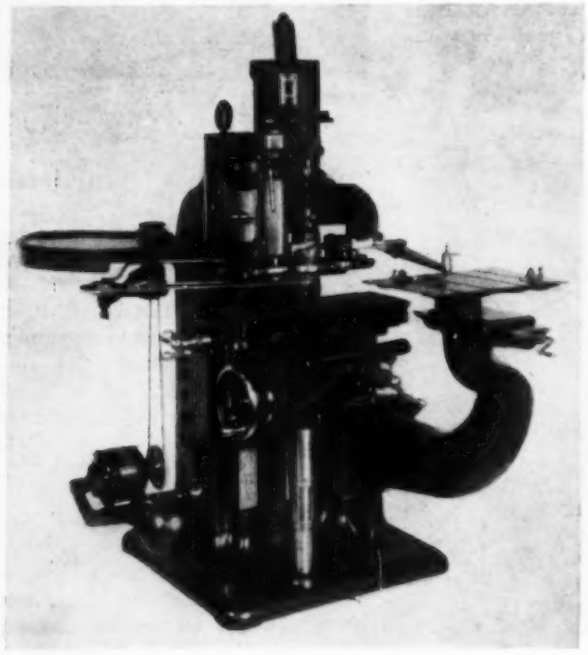
A quick-removable spindle permits grinding cutters while in place in the spindle. An improved forming attachment permits working on curves of small radius and on very steep angles. The master copy and work are almost on the same plane to enable the operator to watch both simultaneously. Precision ball bearings are used throughout the machine.

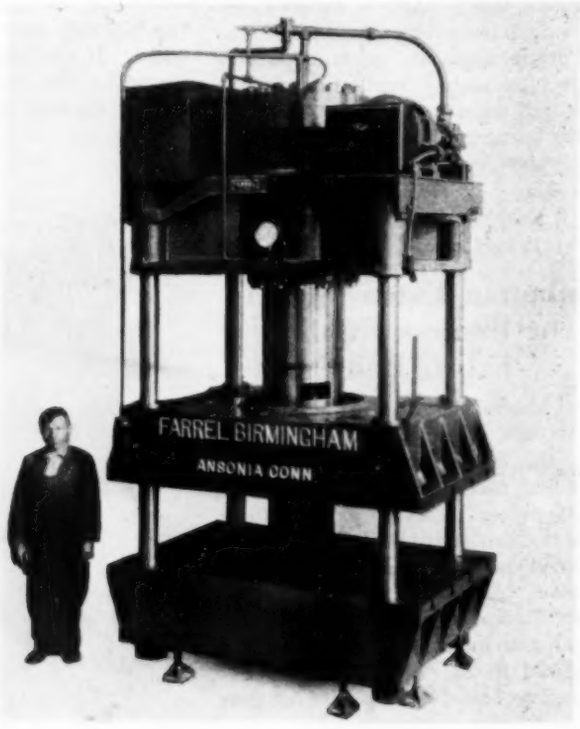
Specifications: Table longitudinal feed, 12 in.; cross feed, 8¾ in.; vertical feed, 10¼ in.; floor space, 42x58 in.; height, 63 in.; weight, 1,800 lb. The machine can be supplied with either a small or large pantograph depending on the size of the work.

## Farrel-Birmingham 200-Ton Hydraulic Press

A self-contained hydraulic press of 200 tons capacity has been furnished by the Farrel-Birmingham Co., Inc., Ansonia, Conn. This press has a 24-in. ram having a 24-in. stroke. The single cylinder is of the double-acting type. The 49½- by 80-in. moving platen is made of special alloy iron and is equipped with renewable bushings that have Alemite fittings. Bottom platen and the top crosshead are made of the same material as the moving platen.

Oil is supplied to the cylinder by a motor-driven pump mounted on top of the press. Oil supply is contained in a welded steel tank. Pressure on the ram is adjustable by means of quick-resetting





relief valves. There are no operating valves. All movements are controlled by a pendant switch with three push-buttons for "stop," "start" and "reverse." The press control can also be equipped with an automatic timing device to provide for a dwell of any desired length of time.

## General Electric Electrode Holder for Atomic-Hydrogen Arc-Welding

An electrode holder for welding with flexible tungsten electrodes has been developed by the General Electric Co., Schenectady, N. Y., for atomic-hydrogen arc-welding. These flexible electrodes are carried in curved tubes, forming a part of the holder, and are brought into position by means of a screw feed ejector. The holder will make it easy

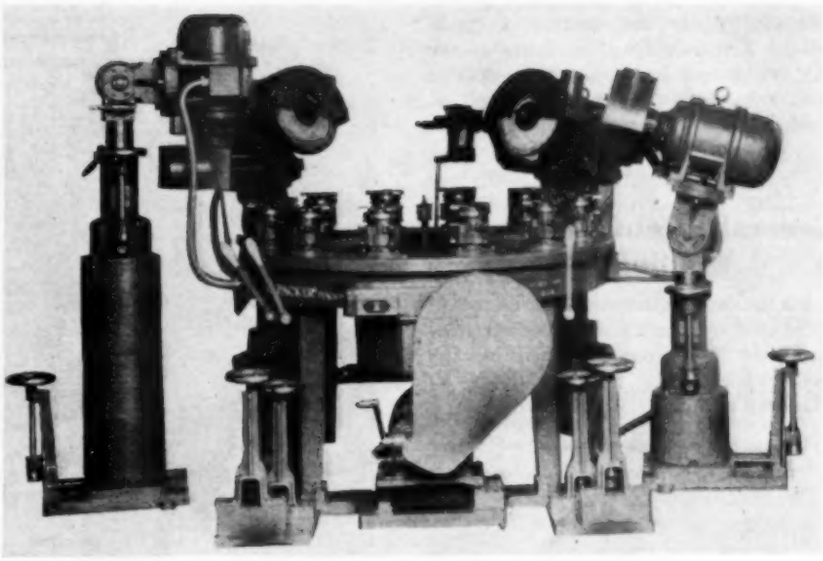
for the operator to work in confined places, and the flexible electrodes should lower the operating cost by reducing breakage.

The electrode is made up of several small diameter tungsten wires stranded together. Consumption is the same as that of the rod type. The electrode is easily adjusted by means of the screw feed ejector, and can be consumed to a length of approximately 1½ in., at which point it will drop out of the nozzle tip. Holder tubes are easily detached from the handle, and the purchaser can make any necessary replacements at his own plant. The flame may be controlled to be either parallel to or at right angles with the axis of the handle by a slight turn of a thumb screw.

## Packer No. 2 Automatic Polishing-Buffing Machine

The Packer Machine Co., Meriden, Conn., has added the No. 2 size to its line of buffing and polishing machines. This machine can be furnished with four or five wheelheads, each driven by a ball bearing, totally inclosed, dust-proof motor. Motors of 3, 5 and 7½-hp. can be used on the heads.

Universal adjustment permits the wheel to be set to any angle from horizontal to vertical and to swivel. The

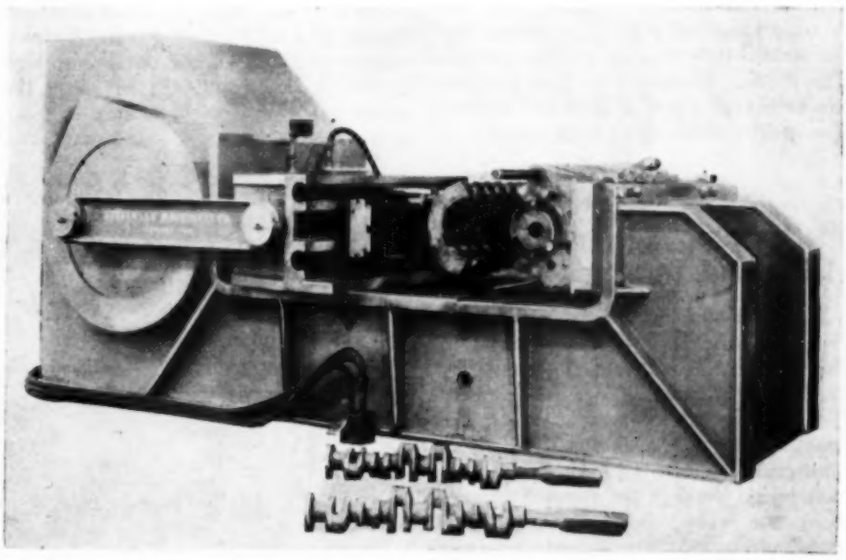


wheelhead pedestal can be adjusted longitudinally. Work up to 12 in. in diameter is the maximum that can be buffed or polished. The worktable has 12 spindles, each with automatic expansion chuck, and rotates with intermittent motion. It is driven by a four-speed motor. Dwell may be set to suit the nature of the work and required finish. The machine is equipped with mechanical composition feeding devices for the wheels. Sheet-metal dust-exhaust hoods are furnished.

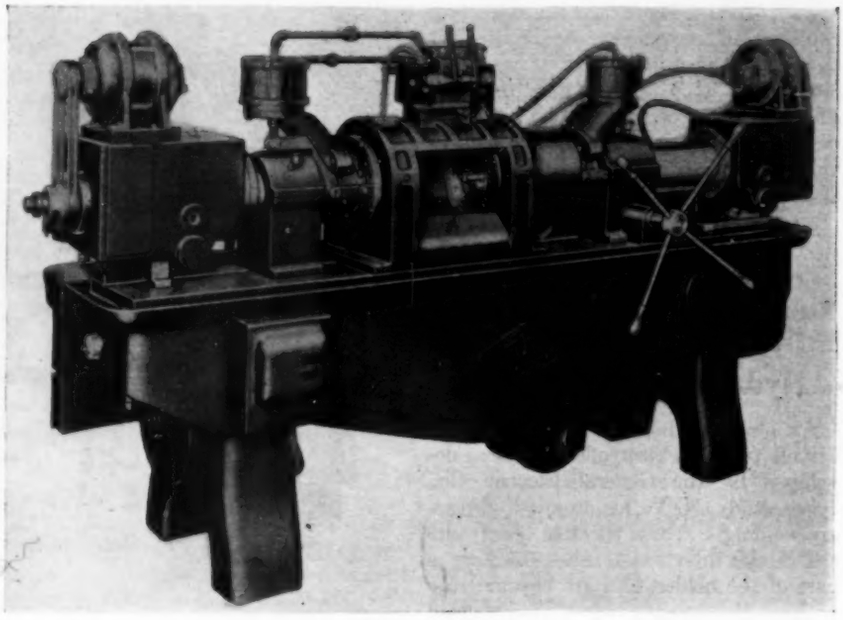
## "Steelweld" Crankshaft Twisting Machine

The Steelweld Machinery Co., E. 70th & Machinery Ave., Cleveland, Ohio, recently developed a machine to twist crankshafts. It will handle crankshafts from very small 4s, up to crankshafts 72 in. long and as large in the bearing diameter as may be desired. This twister is customarily arranged to make four twists at one time, but eight or more twists can be made simultaneously. Any multiple-throw crank can be twisted, all pins being held to commercial limits and the main bearings held in line. This can be accomplished in less than 1 min. per crankshaft, including loading and unloading time.

In addition to the dies and actuating mechanism, the unit differs from the usual bulldozer, to which it has a likeness, in several respects. It carries a double ram. The rams operate independently of one another. The tool is deeper in the throat than is usual with this type of machine. It is driven by a 35-hp. motor with pushbutton controls so that the operator can stop, start and reverse the main drive by pushbutton

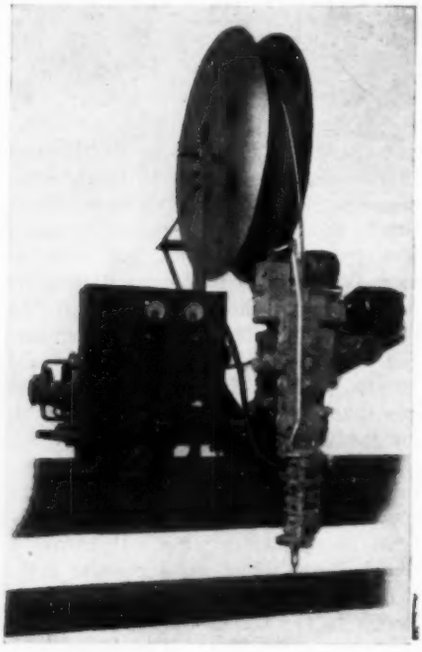


and control the die movement by a pedal. Controls may be mounted at any convenient position. Main frame, ram, side arms and gearing are all of welded, rolled-steel construction.



## General Electric Automatic Welding Head

For welding automatically with heavily coated electrode, an improved welding head has been developed by the General Electric Co., Schenectady, N. Y. The head has capacity for heavily coated

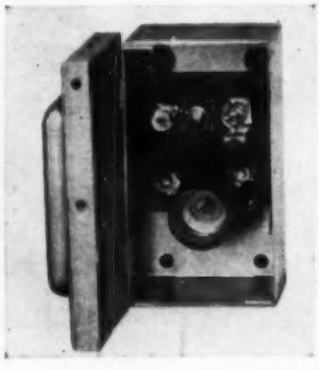


electrode up to 5/16 in. in diameter and is rated up to 600 amp. Modification of its design can be made for larger electrodes and heavier welding currents. A wide range of plate thicknesses can be welded by making several passes. The welding head is of interest to manufacturers of Class I pressure vessels. The welder operates at high speed.

## "Cimatool" Duobore Diamond Boring Machine

Simultaneous diamond boring of work from opposite ends is the function of the "Duobore" machine announced by the City Machine & Tool Works, East Third at June Sts., Dayton, Ohio. The machine is built for boring all kinds of transmission gears, and where used for double-end bearings the opposed spindles bore the piece from opposite ends simultaneously. When used on single bearing gears, two pieces of work are set up in the machine and bored simultaneously.

This "Cimatool" machine is equipped with Bolender gear chucks, and the boring spindles are fed forward through the chucks. Spindles are carried by housings in which each spindle is supported by precision ball bearings, and each spindle is driven by a motor. A third motor under the machine actuates cams which feed the spindles to the work and withdraw them after the boring operation has been completed. Hydraulic pressure is used to close the two chucks.

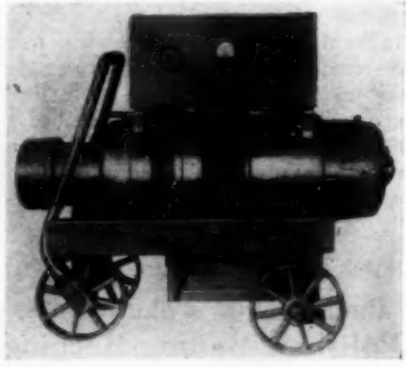


## Square D 1-Hp. Disk Switch

A small, compact and low-priced front-operated switch for rebuilt machinery and appliance installations has been developed by the Switch & Panel Division, Square D Co., Detroit, Mich. Catalog number is 90211. While but 5⅜ in. high by 3⅛ in. wide and 2¾ in. deep, the switch has a capacity of 30 amp. or 1 hp. at 125 volts. It is a 2-pole switch with one fuse, one blade and solid neutral. Front operation is obtained by a small disk rotating between two spring copper blades.

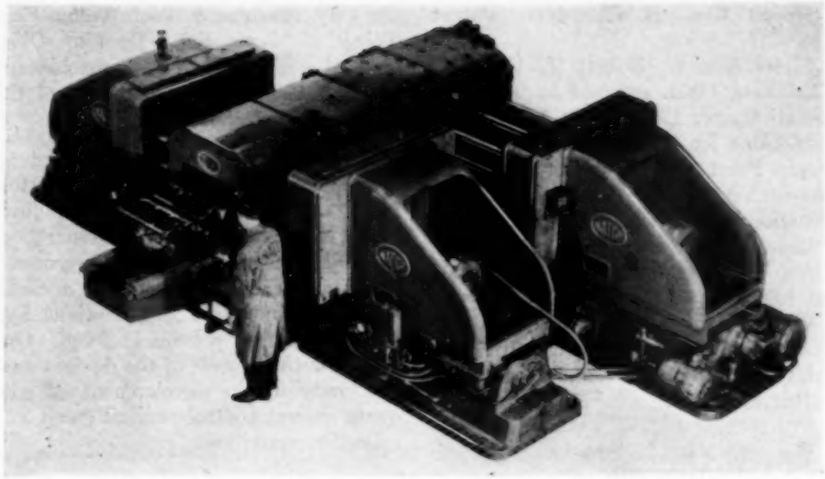
## "Imperial" Arc Welder

Arc welders from 100 to 800 amp. and larger are embodied in the improved line announced by the Imperial Electric Co., Akron, Ohio. The Bryant Machinery & Engineering Co., 400 W. Madison St., Chicago, Ill., is the national distributor for this line. Machines may be had in motor-driven, gas-engine-driven, belt-driven, and track welder arrangements.



In the larger machines special attention has been given to adapting them to heavy plates.

Features of the welder are dual control for close regulation of the welding heat, separate excitation for quick recovery, reverse polarity switch, and rubber mounting. The control box is of the dead front type. The reverse polarity switch is of the toggle type.



## Natco Drilling and Boring Machine for Cam and Crankshaft Bearing Holes

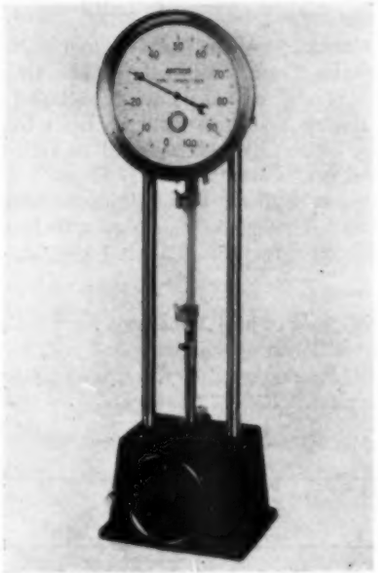
A special, hydraulic-feed drilling and boring machine has been furnished by the National Automatic Tool Co., Richmond, Ind., for the rough and finish boring operations on the cam and crankshaft bearing holes and also core drilling and counterboring the welch plug holes of a new six-cylinder cast-iron cylinder block. The two front heads are mounted upon special Natco Type C 6-in. hydraulic units, each arranged with 24-in. travel. Heads are of Type D construction and are equipped with roller bearing spindles arranged with nose adjustment.

The rear right-hand head is mounted upon a special Type C 8-in. hydraulic unit arranged with 42-in. travel. The head is of Type D construction. The three large units are mounted against and bolted to a large welded steel pedestal, upon which is mounted a four-position automatic conveyor-type fixture arranged to hold two cylinder blocks in each position. The fixture is operated hydraulically and interlocked electrically to the heads.

While heads are completing their cycles, the conveyor returns to the loading position and the operator again loads two cylinder blocks. Complete control of the machine is accomplished through the use of one pushbutton station. Approximate production is 75 cylinder blocks per hour.

## Amthor No. 270 Tensile Strength Testing Machine

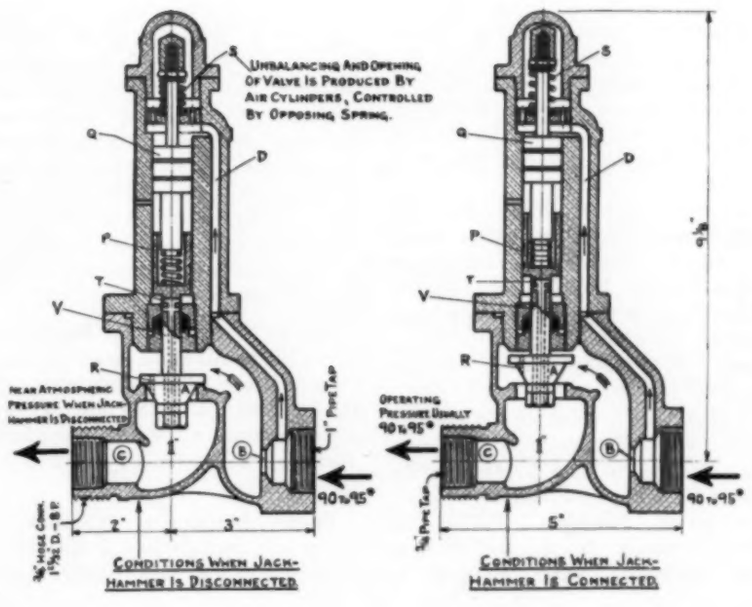
Amthor Testing Instrument Co., Inc., 309 Johnson St., Brooklyn, N. Y., has developed a No. 270 tensile strength testing machine, in which accuracy, simplicity of operation, and rapidity of testing are features. The dial is 8½ in. in diameter, and is graduated directly in fractions of either pounds or kilograms. The dynamometer spring movement is constructed so that sensitivity and elimination of friction are obtained by a free-floating movement. When the specimen breaks, the pointer remains at the breaking strength.



## Yarway-Becker Air Valve

An automatic air-control valve, which permits definitely limited quantities of air to pass at various pressures, the quantity varying directly as the pressure, has been placed on the market by the Yarnall-Waring Co., 7700 Norwood Ave., Philadelphia, Pa. This valve was designed to prevent waste of air in the operation of pneumatic jack-hammers in coal mines, but it is of use for pneumatic tools in foundries and machine shops in that the shop pressure will be maintained more uniform and higher. The valve is placed near the end of the air line. It consists of a globe valve body and separate operating mechanism.

The valve consists of a piston in the operating housing connected by means of a hollow valve rod to the valve disk. This disk has a 1/16-in. hole. When the line beyond the valve is tight, pressure is established because of the air leak through the disk. When this pressure beyond the disk approximates that of the main line, the valve opens against the spring. An orifice in the valve body on the incoming side causes a pressure drop through the valve, varying with volume. By spring adjustment the valve will close at any predetermined line pressure drop, corresponding to the



volume flow. To compensate for variable line pressures, a second piston is employed to compress the spring in direct relationship to the line pressure.

## • PATENTS •

NOVEMBER 8, 1932

**Metal-Working Machinery**

Apparatus for Testing Gear Teeth. Gustof L. Hansen, Detroit, Mich., assignor to The Gear Grinding Machine Co. Patent 1,886,543.

Grinding Machine. Thomas C. Pew, Ann Arbor, Mich., assigned to Hoover Steel Ball Co. Patent 1,886,579.

Universal Automatic Grinder, Polisher or Buffer. Carl B. Larson, Maplewood, N. J., assigned to William C. Hammond. Patent 1,886,699.

Dressing Attachment for Screw Thread Grinders. Alden M. Drake and Norman J. Crowley, West Hartford, Conn., assigned to Pratt & Whitney Co. Patent 1,886,796.

Machine Tool Structure. Fred A. Parsons, Milwaukee, Wis., assigned to Kearney & Trecker Corp. Patent 1,886,863.

Lapping Machine. Otto R. Reller and Clarence W. Hallene, Moline, Ill., assigned to Moline Tool Co. Patent 1,886,836.

Multiple-Spindle Tapper. Albert J. Gifford, Worcester, Mass., assigned to Leland-Gifford Co. Patent 1,886,091.

Grinding Machine. Maldo J. Guild and Alfred P. Burns, Worcester, Mass., assigned to The Heald Machine Co. Patent 1,887,154.

NOVEMBER 1, 1932

**Metal-Working Machinery**

Die Lapping and Grinding Machine. Rudolph Bsteh, Vienna, Austria. Patent 1,885,178.

Dial Arrangement for Nut Making Apparatus. Samuel W. Avis, Millbrook, Greenwich, Conn., assigned to Russell, Burdsall & Ward Bolt & Nut Co. Patent 1,885,215.

Automatic Tool Machine. Earl W. Brinkman and Edward S. Kline, Rochester, N. Y., assigned to Davenport Machine Tool Co., Inc. Patent 1,885,224.

Fluid Pressure Operated Steady-Rest. Raymond A. Cole, Worcester, Mass., assigned to Norton Co. Patent 1,885,233.

Machine for Making Capscrew Blanks. John E. Pracny, Waterbury, Conn., assigned to The E. J. Manville Machine Co. Patent 1,885,288.

Die-Casting Machine. William J. During, Syracuse, N. Y., and Nathan Lester, Cleveland, Ohio, assigned to Precision Castings Co., Inc. Patent 1,885,421.

Metal Shears. Robert T. Hazelton, Cincinnati, Ohio, assigned to The Cincinnati Shaper Co. Patent 1,885,438.

Machine for Cutting Double Thread, Single Point Screws. John A. Arenz, Mount Vernon, N. Y., assigned to International Screw Co. Patent, 1,885,792.

Grinding Machine. James Dronsfield, Atlas Works, Oldham, England. Patent 1,886,089.

Grinding Apparatus. Folke Kylberg, Gottenborg, Sweden, assigned to Aktiebolaget Tonsor, Gottenborg, Sweden. Patent 1,886,274.

**Tools and Attachments**

Radius Forming Fixture. Mearl J. Chapman, Cleveland, Ohio, assigned to Great Lakes Aircraft Corp. Patent 1,886,082.

Chuck. Albert E. Church, New Britain, Conn., assigned to The Union Manufacturing Co. Patent 1,886,083.

Boring Tool and Holder. Emil Gairing, Detroit, Mich., assigned to Gairing Tool Co. Patent 1,886,177.

Screw Cutting Tool. John A. Arenz, Mount Vernon, N. Y., assigned to International Screw Co. Patent 1,886,240.

**Processes**

Method of and Apparatus for Cutting Worm Gearing. Samuel I. Cone, Norfolk, Va., assigned to Cone Worm Gearing Corp. Patent 1,885,686.

## • TRADE PUBLICATIONS •

ATTACHMENT FOR SPHERICAL TURNING. The U. S. Department of Commerce, Bureau of Standards, has issued Research Paper No. 467 entitled "An Attachment for Turning Approximately Spherical Surfaces of Small Curvature on a Lathe," by I. C. Gardner, Bureau of Standards. An article has been published earlier (*AM*—Vol. 76, p. 994). The bulletin is available from the Superintendent of Documents, Washington, D. C., for $0.05.

BOTTLE OILERS. The Lunkenheimer Co., Cincinnati, Ohio, has issued a bulletin entitled "Lunkenheimer Bottle Oilers—Their Construction, Operation and Application," showing methods of mounting the various types and giving specifications.

BORING MACHINES. "Cimatool" diamond and carbide boring machines are described in the new folder issued by the City Machine & Tool Works, East Third at June Sts., Dayton, Ohio. Typical work done on these machines is illustrated and the specifications of the three types are listed.

CREDIT MANAGEMENT. Published by the Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y., is the report entitled "Effective Credit Management" which analyzes the reasons for a credit service in industrial organizations and lists the general policies in force. One section outlines some of the devices used effectively in the development of adequate current control over all credit and collection activities.

HEAT-TREATMENT OF STEEL. E. F. Houghton & Co., Third, American & Somerset Sts., Philadelphia, Pa., has issued a publication known as "Houghton on Liquid Baths for the Heat-Treatment of Steel." In addition to describing the types of salts used for all heat-treating operations that can be done in liquid baths, this book gives information on the design and operation of salt bath furnaces and speaks of many factors that contribute to greater economy in heat-treating. The quenching of high-speed steel in a salt bath is also described.

MOTOREDUCERS. The Philadelphia Gear Works, Erie Ave. at G St., Philadelphia, Pa., has issued a catalog on the horizontal and vertical "MotoReduceRs" described in recent issues. Blueprints, mounting dimensions, specifications for reductions and overhung loads are found in the 16 pages.

SHIPMENT OF SAMPLES ABROAD. The 1932 revised edition of "Shipment of Samples and Advertising Matter Abroad," issued as Trade Promotion Series No. 72 by the U. S. Department of Commerce, says "The fact is not generally realized that samples and catalogs for foreign destinations cannot simply be dropped in the mails. Even single copies of catalogs are dutiable in some countries." The book is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., for $1.00, buckram bound.

ZINC FOR DIE-CASTINGS. The New Jersey Zinc Co., 160 Front St., New York, N. Y., has issued a publication "Horse Head Zinc for Die-Castings" in which appear for the first time charts and a table on the effect of aging treatments on tensile strength, impact strength and dimensions of zinc alloys. Heat-treatment for stabilizing the dimensions and properties of a zinc die-casting alloy is given. Inserts, machining and finishing operations are discussed.